

WE ARE SYMMETRYS

BASEMENT IMPACT ASSESSMENT

GARAGE SITE ON FERRESTONE ROAD
N8 7BX LONDON

22135-SYM-XX-XX-RP-S-0001 A



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1.0 Introduction

- 1.1 Symmetrys Limited have been engaged by Appleton Weiner Architects to produce a Basement Impact Assessment for the proposed three storey building over 1-storey basement at a garage site on Ferrestone Road, N8 7BX London. The overall project consists of demolition of the existing garage (Figure 1) and construction of a new private residential building.



Figure 1. Existing Site, highlighted in green.

- 1.2 Symmetrys drawings and this report form part of the architect's planning application. These documents are not intended for, and should not be relied upon, by any third party for any other purpose. Symmetrys drawings are based on the existing and proposed drawings provided by Appleton Weiner Architects.
- 1.3 Symmetrys Limited have carried out a preliminary design of the proposed basement. The resulting structural drawings can be found in Appendix A.

2.0 Authors

- 2.1 The Basement Impact Assessment has been authored by Simone Boncio (BSc MSc), Senior Structural Engineer at Symmetrys.
- 2.2 The report has been reviewed by Anna Beckett (CEng MStructE), Associate Director at Symmetrys.
- 2.3 The Floor Risk Assessment and SuDs strategy was authored by Yare Perez (BEng) Civil Engineer at Symmetrys, and reviewed by Rachel Field (MSc BEng) Principal Civil Engineer at Symmetrys.
- 2.4 The Ground Investigation & Assessment Report has been authored by Philip Lewis (BSc, MSc, CGeol, FGS) Chartered Geologist and Director of LMB Geolsolutions.

3.0 Sources of Information

- 1.4 The following reference documents have been used as guidance in compiling this report;
- "Local requirements for information to be submitted with planning applications", Haringey, July 2021;
 - Development management DPD, including Policy DM18, Haringey, July 2017;
 - Haringey Council Strategic Floor Risk Assessment, February 2015;
 - British Geological Survey (BGS) Geology of Britain Viewer;
 - WW2 Bomb Census Bomb Site Map;
 - Rail Map Online Historic Railway, Railroad & Canals Map;
 - The Lost Rivers of London (Barton, N.L, 1982);
 - Guidelines of safe and efficient basement construction directly under or near to existing structures, Association of Specialist Underpinning Contractors (ASUC), 2013.

4.0 Existing Site

- 4.1 The site is located on Ferrestone Road, in the London Borough of Haringey.
- 4.2 The site is currently occupied by a single storey garage.
- 4.3 The site is delimited on the western side by 1 Ferrestone Road, a 3-storey semi-detached house, on the eastern side by a shed contained within the rear garden of a property at 17 Church Lane, and on the south-eastern corner by the rear garden of a property at 16 Church Lane.

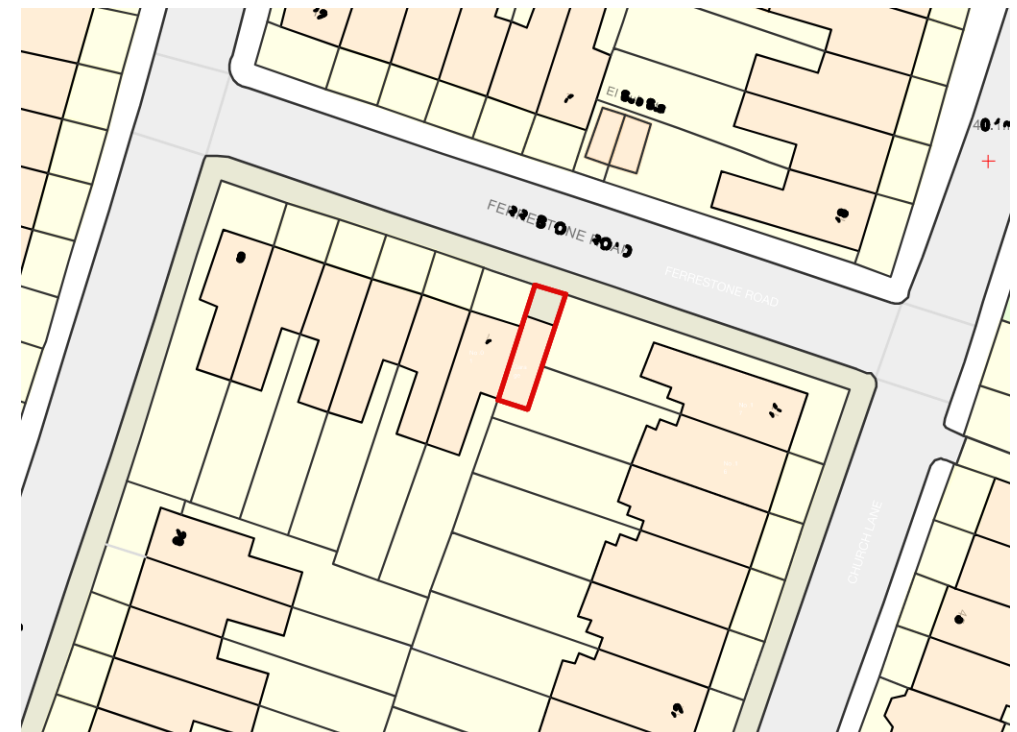


Figure 2. Location plan.

5.0 Desktop Study

5.1 Ground Conditions

- 5.1.1 According to the British Geological Survey (BGS) 'Geology of Britain' digital map, the site is located directly over the London Clay Formation.
- 5.1.2 Historical site investigation information available on the British Geological Survey website shows a number of investigations have been undertaken within the vicinity of the site. Borehole logs from a selection of these reports, including TQ38NW4 approximately 100m north of the site, indicate brick-hearth overlying soils interpreted as the London Clay Formation.

5.2 Bomb Damage

- 5.2.1 The 'Bomb Sight' archive has identified multiple areas within 250m from the site targeted by WW2 bombing.
- 5.2.2 The closest high explosive bomb is located 160m from the site. Therefore, caution must be exercised during the ground works.

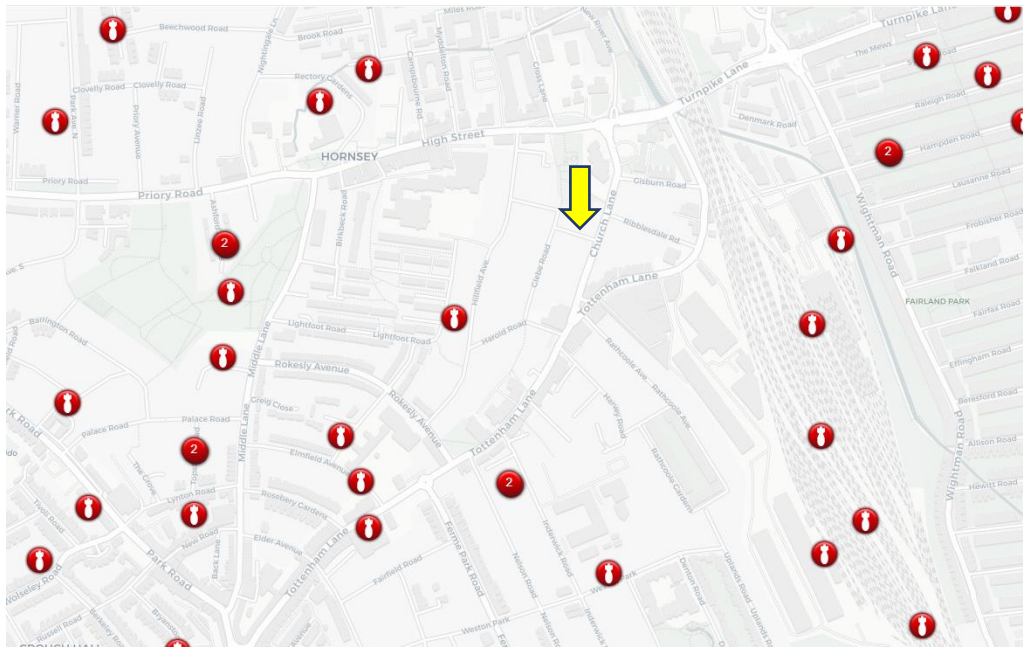


Figure 3. Site location and WW2 bombings

5.3 Hydrology

- 5.3.1 Figure 5 shows the indicative flood risk map taken from the Environment Agency web site. It can be seen that the site falls within Flood zone 1, an area with a low probability of flooding.
- 5.3.2 Information contained on the gov.uk website indicates that the site is in an area at very low risk of flooding from rivers and sea and low risk from surface water flooding.
- 5.3.3 The data included in the Haringey Council Strategic Flood Risk Assessment shows that the site is in the wider vicinity of watercourses. The nearest surface water feature is the New River, approximately 280m northeast of the site.
- 5.3.4 The Moselle Brook, now culverted, is located approximately 370m northwest of the site.
- 5.3.5 The site falls within a Critical Drainage Area (Group4_055). Therefore, a flood risk assessment is required.

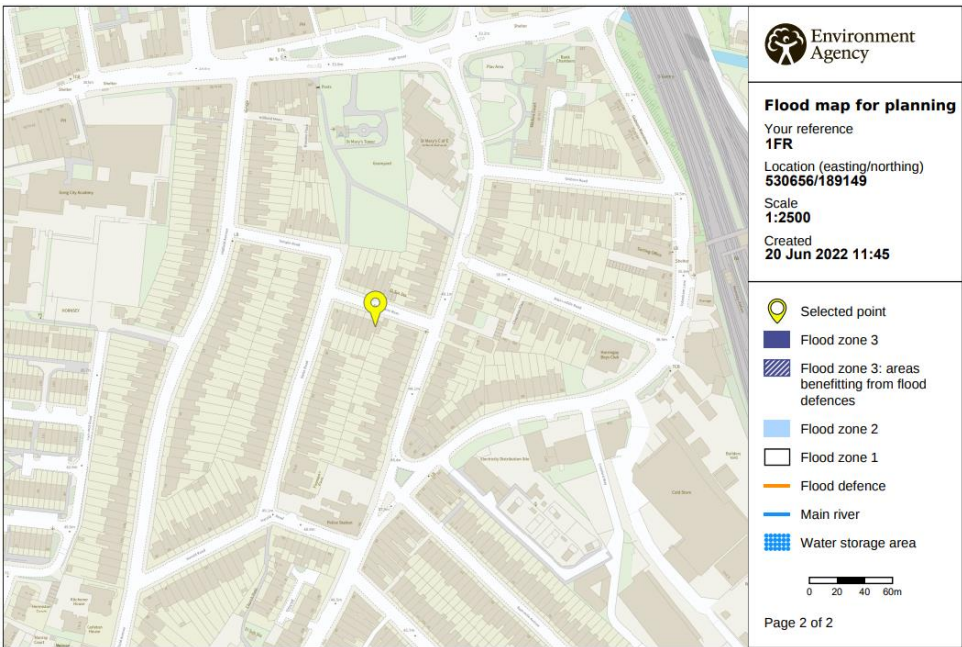


Figure 4. Environment Agency Flood Map for Planning

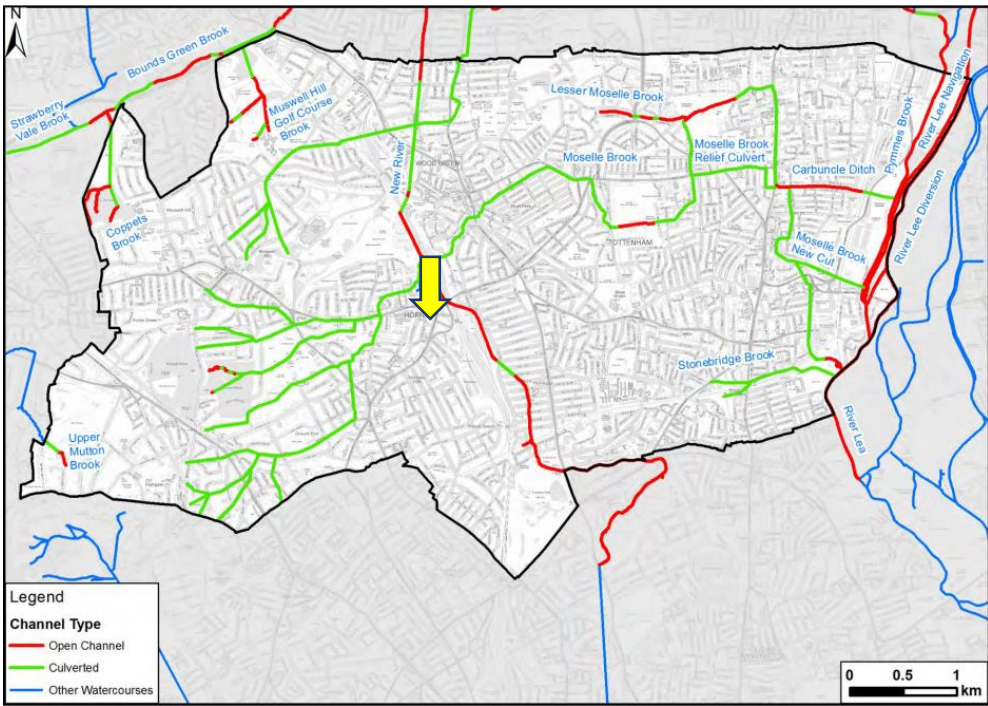


Figure 6. London Borough of Haringey. The New River is indicated as an open channel, while the Moselle Brook as culverted.

- 5.4Overground and Underground Railway Infrastructure
- 5.4.1Figure 7 shows the position of proposed basement in relation to the existing and historic railway routes. The closest railway infrastructure is located approximately 250m east of the site.
- 5.4.2The proposed development is unlikely to have any impact to the existing over ground or underground network rail system.
- 5.5Underground utilities
- 5.5.1CAT scan, safe digging practices (as contained in HSE publications) and other appropriate investigative techniques should always be adopted.

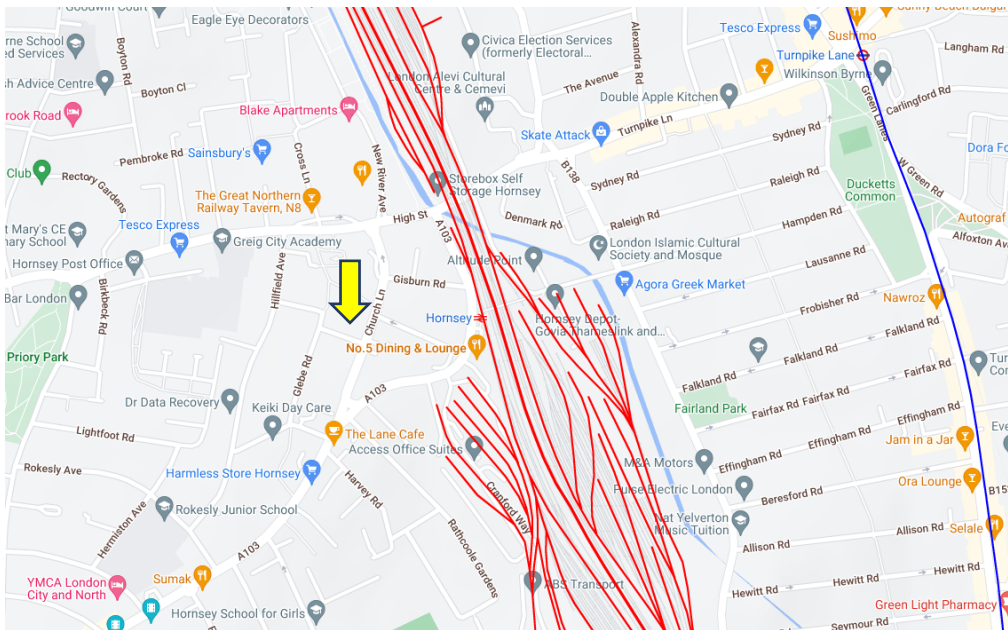


Figure 7. London Transport historic map. The red line shows branches of the historic network no longer in use.

- 6.0Ground Investigation
- 6.1A ground investigation was carried out by specialist geotechnical engineers LMB Geosolutions Ltd. Their geotechnical report is provided in Appendix C.
- 6.2One borehole was excavated at the rear of the site to a maximum depth of 10m where stiff clay was encountered. See Appendix C for details.
- 6.3Groundwater was not encountered during the ground investigation works or during the return monitoring. The appointed contractor should allow for dewatering measures should perched water be encountered during excavation and construction works.
- 6.4A Waste Acceptance Criteria analysis (WAC) was carried out. The test, undertaken on a sample of Made Ground, indicated that the soil would meet non-hazardous waste landfill waste acceptance criteria.
- 6.5The result obtained from tests for buried concrete (Appendix C), indicates that Design Sulphate Class DS-2 should be applied, hence according to BS 8500-1:2006, designated concrete to be DC-1 (min RC25/30).
- 6.6The allowable bearing pressure was found to be 115 kN/m² at 3m below ground level.

- 7.0Design Proposal
- 7.1The design proposal is to construct a single storey basement. The construction methodology shall consist of mass concrete pins underpinning the adjacent property flank wall (1 Ferrestone Road), and reinforced concrete walls around the perimeter of the new building and basement footprint to be cast in underpinning sequence. See Structural Drawings in Appendix A. A ground floor slab is envisaged, which will provide permanent propping to the retaining walls.
- 7.2The retaining walls and the basement slab are proposed to be constructed in a sequential manner in lengths of 1.0m and will be cast in sequence as specified in the temporary works method statement.
- 7.3Heave protection on part of the ground bearing basement slab has been specified to balance the stabilizing vertical permanent load and heave forces.
- 7.4The retaining walls shall have adequate strength to resist anticipated lateral soil forces, water pressure and surcharge loading.
- 7.5Existing trees located on site are to be retained and protected with appropriate protective measures during the course of the construction. Further investigation works must be carried out prior to any construction works to confirm that the proposed foundations meet the requirement indicated in the NHBC Standards, Chapter 4.2 "Building near trees".
- 8.0Temporary Works
- 8.1The proposed temporary works sequence for the basement is provided in Appendix A. The suggested method of construction is based on installing the new foundations and basement walls in a hit/miss excavation sequence, with sections of maximum 1m width excavated below or adjacent to the existing structures. The purpose of this methodology is to minimise the quantity of temporary works required.
- 8.2The proposed methodology is for design development purposes only and for the purposes of this planning application. The appointed contractor will be responsible for all temporary supports and for the stability of the structure during the works.
- 8.3To ensure that the retained engineer's intent is correctly interpreted by the contractor, they will be required to submit all temporary works proposals for review a minimum of 7 working days prior to commencing works. The contractor should also submit a dewatering strategy to ensure a strategy is agreed should water be encountered.
- 9.0Construction Method Statement
- 9.1A preliminary sequence of works is provided within the structural drawings in Appendix A (to be confirmed by the contractor).
- 10.0Ground Stability and Stability of Neighbouring Structures
- 10.1Due to the robust engineering principles and construction methods applied, the extent of movement is limited in accordance with British and European codes. We can confirm that the proposed structural design and method of construction of the basement have been developed with a view to ensuring structural safety and that if constructed in accordance with this document, the works will be able to be completed without any adverse impact on the structural stability of the neighbouring properties, other adjacent structure, adjoining land and gardens or the adjoining Public Highway.
- 10.2The reinforced concrete structure will be designed to accommodate surcharges from the neighbouring properties, Public Highway and ground pressures. The structure will have adequate stiffness to ensure that the lateral deflections do not exceed the appropriate limits recommended by British Standards Codes of Practice in order to ensure that potential ground movements be kept to acceptable limits. Appointed contractors will also be advised to carry out movement monitoring as part of the basement construction.
- 10.3The structure will be designed to withstand any uplift due to hydrostatic pressures as well as being designed to transfer vertical loads into the ground safely.

11.0 Drainage and SuDS

- 11.1The site lies within a Critical Drainage Area as identified by the LB of Haringey SWMP (Surface Water Management Plan). Therefore, a Flood Risk Assessment (FRA) has been carried out to provide information regarding the potential flood risk hazards affecting the site and demonstrate that the development is safe for its intended use.
- 11.2The pre-development potential flood risk from all sources of flooding is considered to be 'Low'. FRA Report can be found in Appendix C.
- 11.3The introduction of Sustainable Drainage Systems (SuDS) contributes to mitigate the risk of flood risk by reducing the impact of large rainfall events. By reducing runoff rates, SuDS help to decrease of risk of surface water and sewer flooding.
- 11.4A SuDS Assessment has been carried out using the guidance set out in The London Plan published by Greater London Authority and The SuDS Manual published by CIRIA. SuDS techniques were assessed as possible surface water disposal methods and priority was given to SuDS which provide multi-functional benefits in line with the drainage hierarchy.
- 11.5An outline drainage strategy has been developed. It is proposed runoff is attenuated to 1 l/s to for all rainfall events up to the 1 in 100 +40% climate changes storm.
- 11.6Attenuation is provided by a 1 m deep 1.2m diameter manhole fitted with a 25mm orifice plate flow control.
- 11.7Drainage Strategy sketch and Calcs can be found in Appendix D.
- 11.8New foul and surface water connections to the respective Thames Water sewers in Ferrestone Road are required Connections are subject to Thames Water Section 106 approval.

12.0 Party Wall Matters

- 12.1The proposed works will fall within the Party Wall Act 1996. Procedures under the Act will be dealt with by the client's Party Wall Surveyor. The Party Wall Surveyor will prepare and serve necessary Notices under the provision of the Acts and agree Party Wall Awards in event of disputes. The Contractor will be required to provide the Party Wall Surveyor with the appropriate drawings, method statements and all other relevant information covering the works notifiable under the Act. The resolution of the matters under the Act and provision of Party Wall Awards will protect the interests of all owners.
- 12.2Monitoring

It is proposed that the structural stability of the adjacent properties is safeguarded by a system of movement monitoring. The Contractor shall monitor the position and movements of the elevations of the retained façade and adjacent properties around the perimeter of the proposed excavation. The monitoring shall be undertaken by a specialist survey company. The monitoring system will have at least the following characteristics:

(1)The retained façade and existing façades of the neighbouring properties as well as the flank wall of the neighbouring building will be monitored near ground level and at roof level, at intervals not exceeding 3m centres.

(2)Monitoring points (targets) shall be firmly attached, to allow 3D position measurement, for the duration of the work, to a continuous and uninterrupted accuracy of +/- 1mm. A suitable remote reference base/datum unaffected by the works will be adopted, one located at least 50m from the site.

(3)Points/targets shall be measured for 3D positioning on, at not less than the following intervals:

(a)Before any works commence (base reading).

(b)Weekly during the period of basement excavation/construction.

(c)Fortnightly until permanent structure is in place

(d)Monthly during the course of the remainder of the works.

(e)Six months after the completion of all construction works.

(4)All measurements shall be plotted graphically, to clearly indicate the fluctuation of movement with time. The survey company shall submit the monitoring results to the Engineer (Symmetrys Ltd) and to the Adjoining Owners Party Wall Surveyors/Engineer within 24 hour of measurement, graphically and numerically.

(5)The following trigger levels for movement are proposed for agreement. In the event of a trigger value being reached the Contractor will immediately stop any work that might cause further movement, assess the situation and propose alternative methods for proceeding, with definitive further movement limits for those later steps.

(6)Trigger movement limits are proposed as follows:

Existing Buildings: Horizontal/Vertical Movement	
Amber +/-5mm	All parties notified
Red +/-10mm	Works Reviewed

13.0 Sustainability

13.1As the basement construction will involve significant amounts of concrete, cement replacement alternatives should be considered. Cement replacements can used to replace up to 40% of the cement in concrete mix. These replacements are typically waste products from the energy production industry such as PFA (pulverised fuel ash) and GBFS (granulated blast furnace slag). By adopting them waste products from the energy production industry are recycled and not sent to landfill sites. Furthermore, this also reduces the amount of cement that needs to be mined. Concrete should be bought from a local supplier to further reduce the carbon footprint of transport.

13.2There is a significant amount of reinforced concrete on the project for which steel reinforcement bars will be required. By specifying reinforcement from a UK supplier, it ensures that the rebar is made from 100% recycled steel. Any structural steelwork should be sourced from a British manufacturer to ensure that rolled sections are made from at least 60% recycled steel. Sourcing the steel from a local supplier will further reduce the transport carbon footprint.

14.0 Summary

14.1.1It is essential that a thorough review of all temporary works, contractors' method statements and calculations for these works is undertaken by a suitable qualified structural engineer prior to works starting. The permanent works will also be submitted to Building Control and the necessary Party Wall Surveyors for approval prior to the works commencing on site.

14.1.2The proposed basement has been designed with robust structural principles and methods of construction that are widely used and known. This will ensure the integrity of neighbouring structures and roadways are not compromised during its construction.

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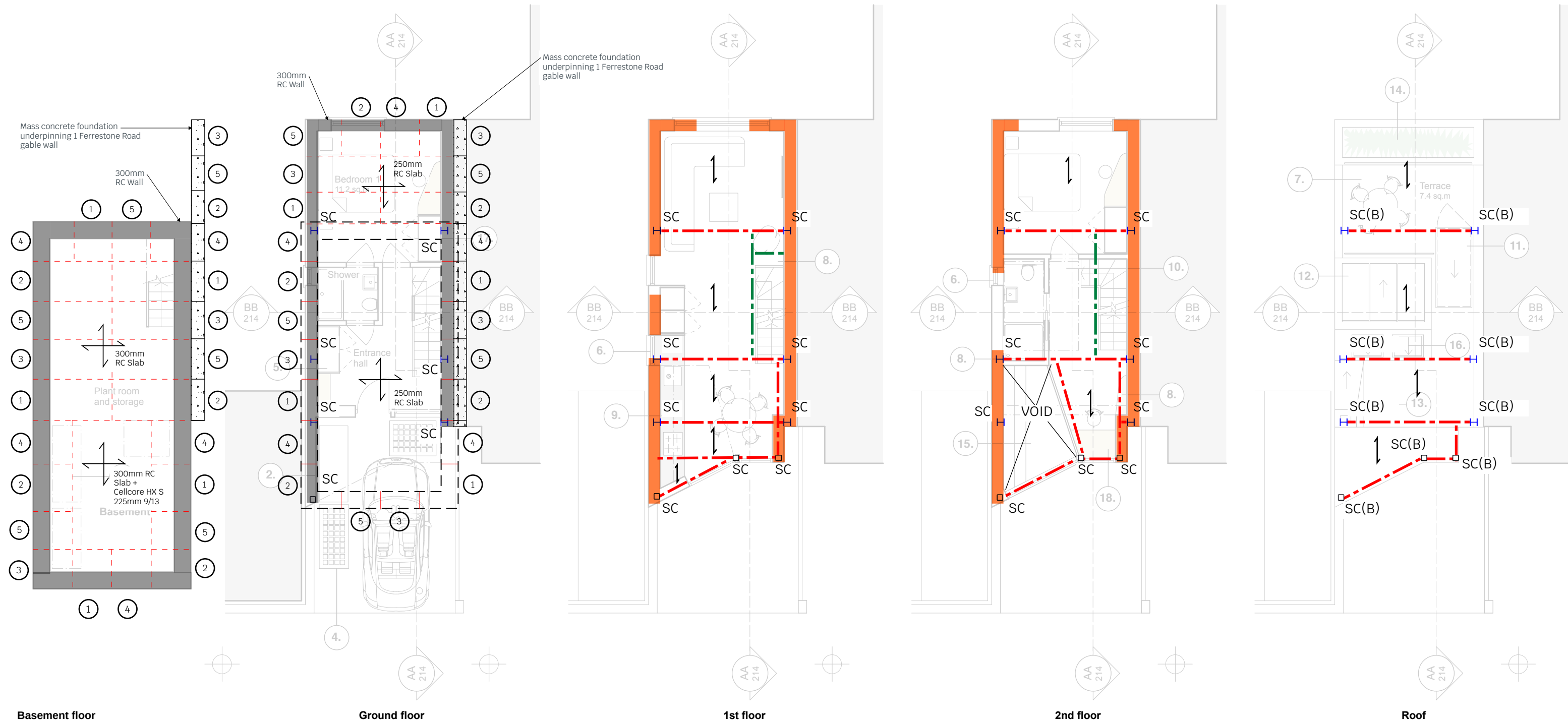


SYMMETRYS
STRUCTURAL / CIVIL ENGINEERS

GARAGE SITE ON FERRESTONE ROAD

APPENDIX A

STAGE 2 DRAWINGS



Basement floor

Ground floor

1st floor

2nd floor

Roof

Notes

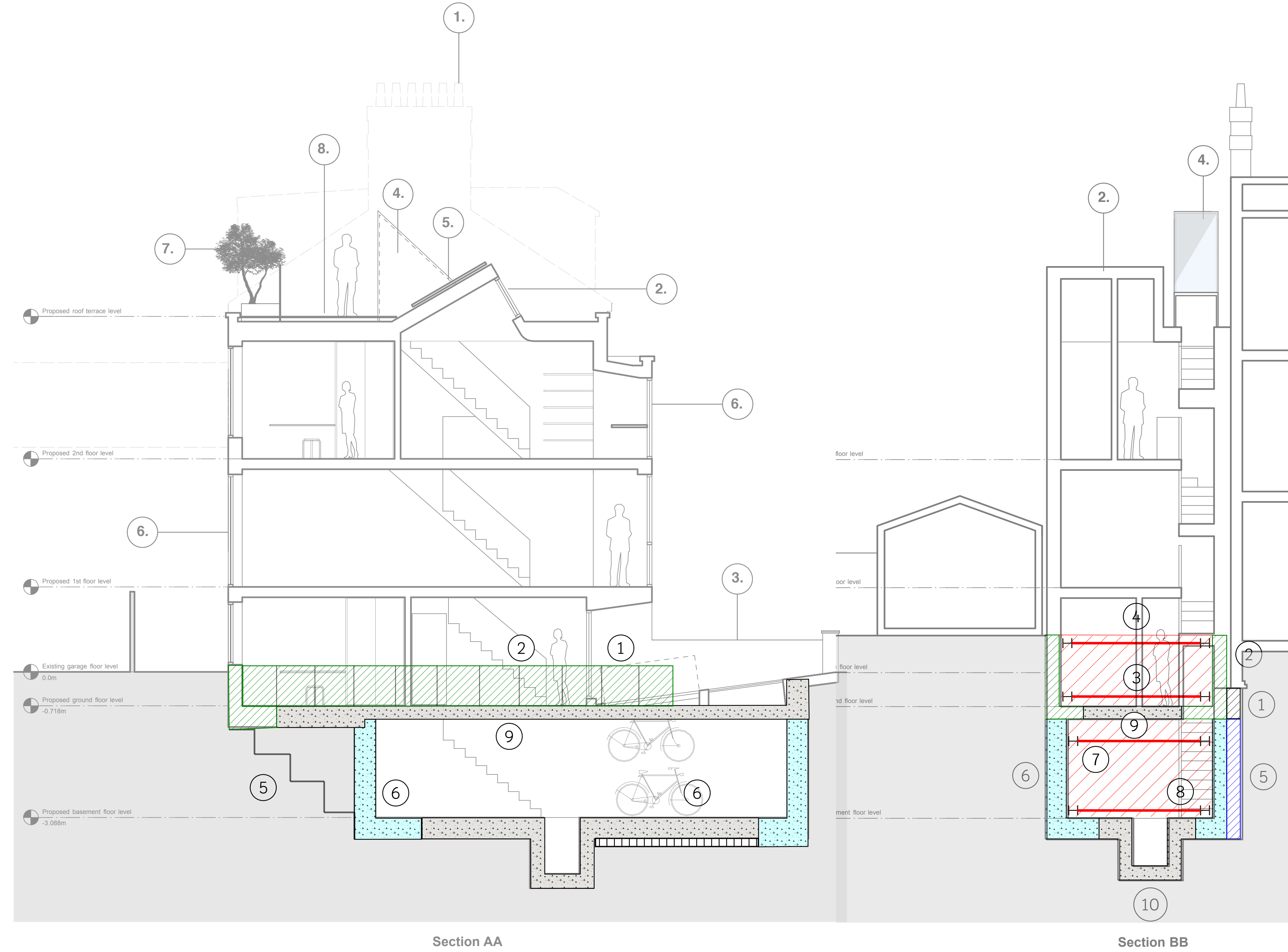
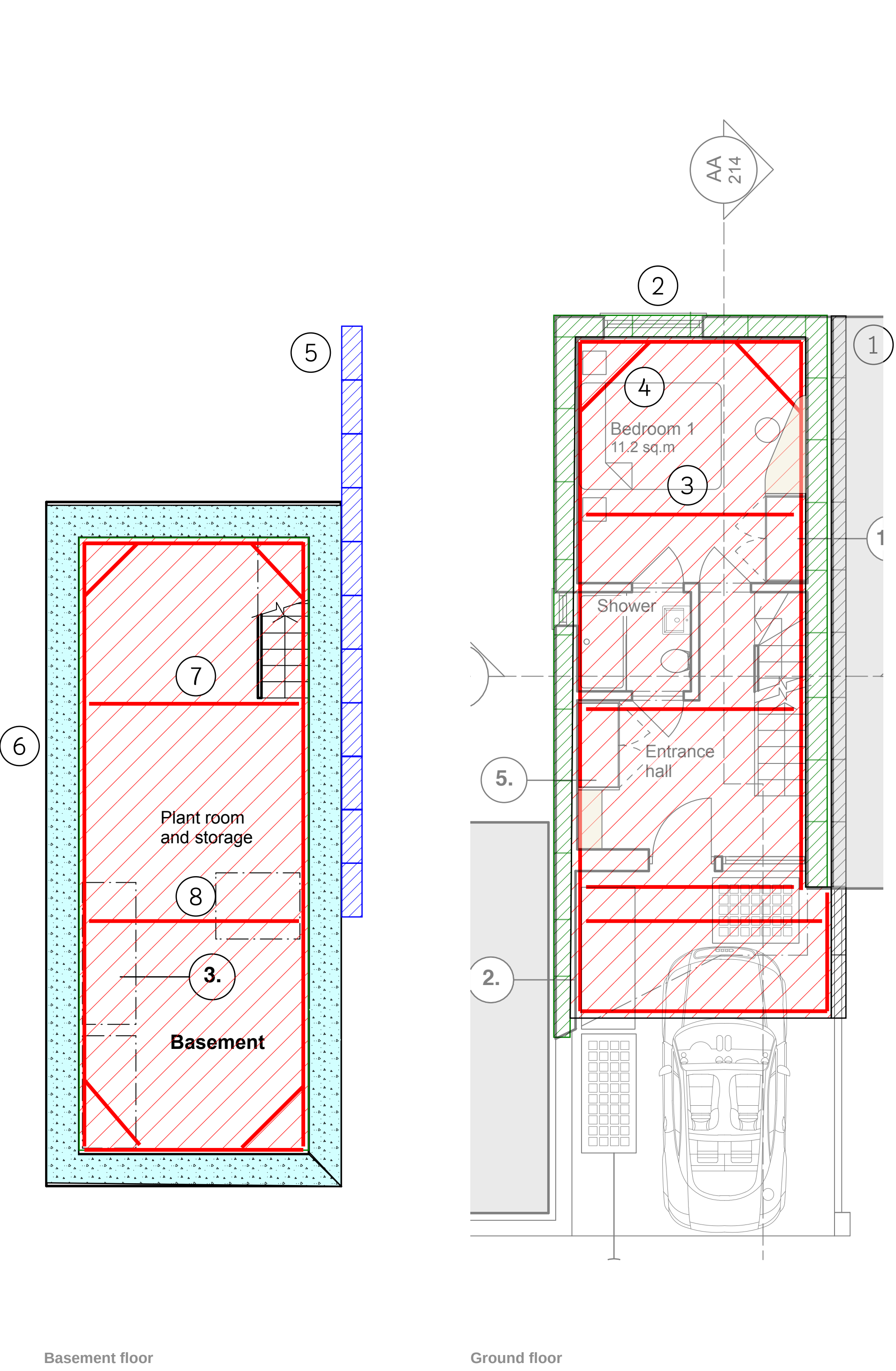
- All element sizes shown are indicative. Sizes TBC following results of site investigation and detailed design.
- Material grades and methodology TBC following results of site investigation.
- Location of existing and proposed drain runs are to be confirmed by the service engineer
- Refer to the Architects drawings for all fire protection to steelwork
- Refer to architects drawing for all setting out details, insulation, ventilation and waterproofing details
- The contractor shall be responsible for the design, installation and sequencing of all temporary works and must ensure that the stability of the structure is not compromised during the works

Contractor/Specialist design items

- All temporary works
- All tanking details

Legend:

-  Denotes new cavity wall
-  Denotes steel beam
-  Denotes steel column
-  Denotes steel column below
-  Denotes timber joist span
-  Denotes timber beam
-  Denotes underpinning sequence



Proposed Sequence of Works

- 1-Underpin the adjoining property gable wall (1 Ferrestone Road) with mass concrete pins to be cast in hit/miss sequence, to a depth matching the proposed ground floor slab bottom face.
- 2-Cast RC retaining walls in hit-miss sequence along the perimeter of the new building to a depth matching the proposed ground floor slab bottom face.
- 3&4 – Remove ground from building footprint to a depth matching the proposed ground floor slab bottom face, allowing for installation of temporary struts and wailing beams to support the RC retaining walls.
- 5- Extend the foundations below the adjoining property gable wall (1 Ferrestone Road) by further underpinning the foundation with mass concrete pins to be cast in hit/miss sequence, to a depth matching the proposed basement slab formation level.

- 6- Cast RC retaining walls in hit-miss sequence along the perimeter of the proposed basement to a depth matching the proposed ground floor slab bottom face, including the extension of the RC wall (see sequence no. 2) along the boundary lines.
- 7&8 – Remove ground from building footprint to a depth matching the proposed basement slab formation level, allowing for installation of temporary struts and wailing beams to support the RC retaining walls.
- 9- Cast RC ground floor slab, including section above heave protection where required
- 10-Cast RC basement slab
- 11- Dismantle temporary works.

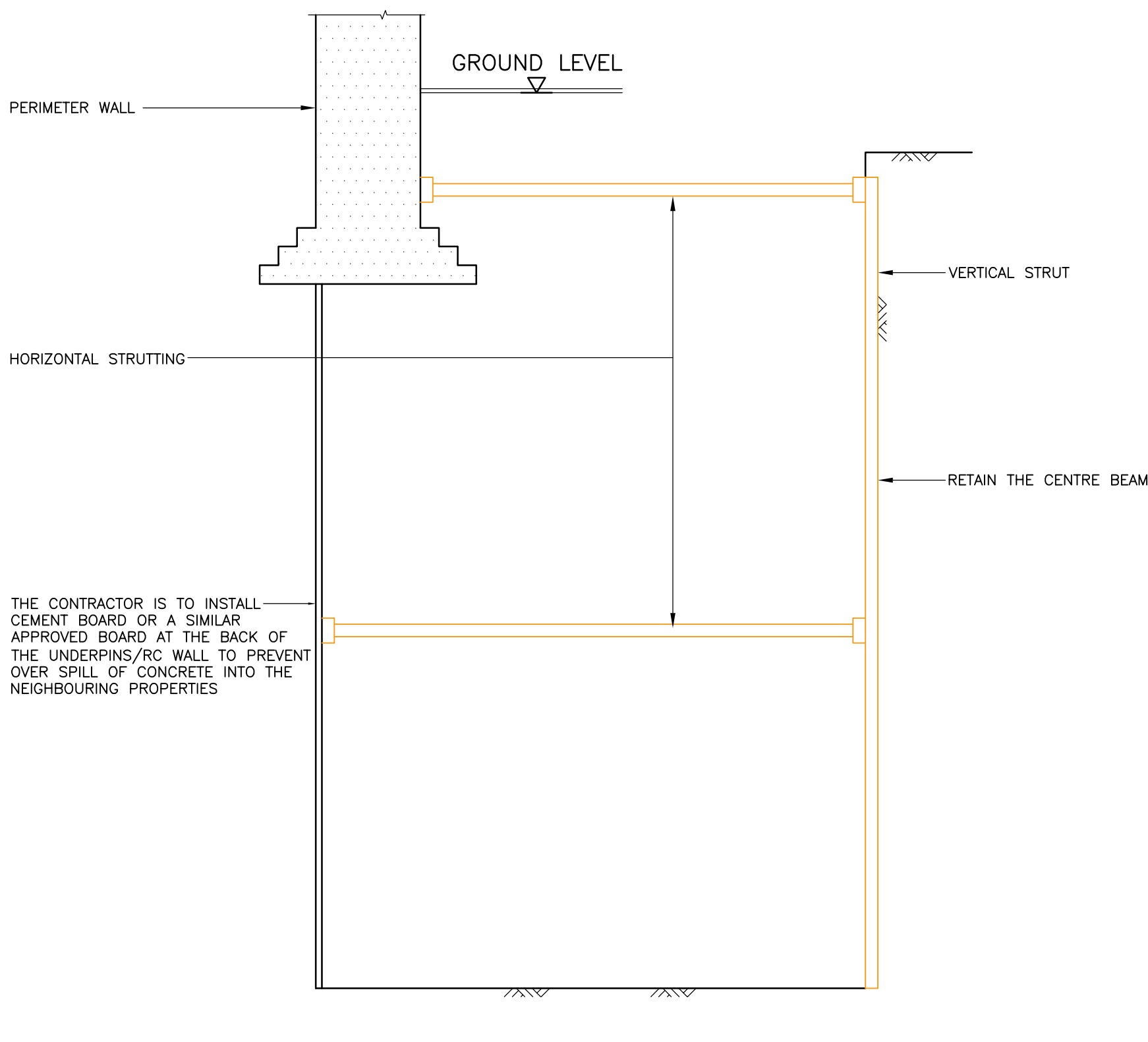
- Notes
- All element sizes shown are indicative. Sizes TBC following results of site investigation and detailed design.
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- Contractor/Specialist design items
- All temporary works
 - All tanking details

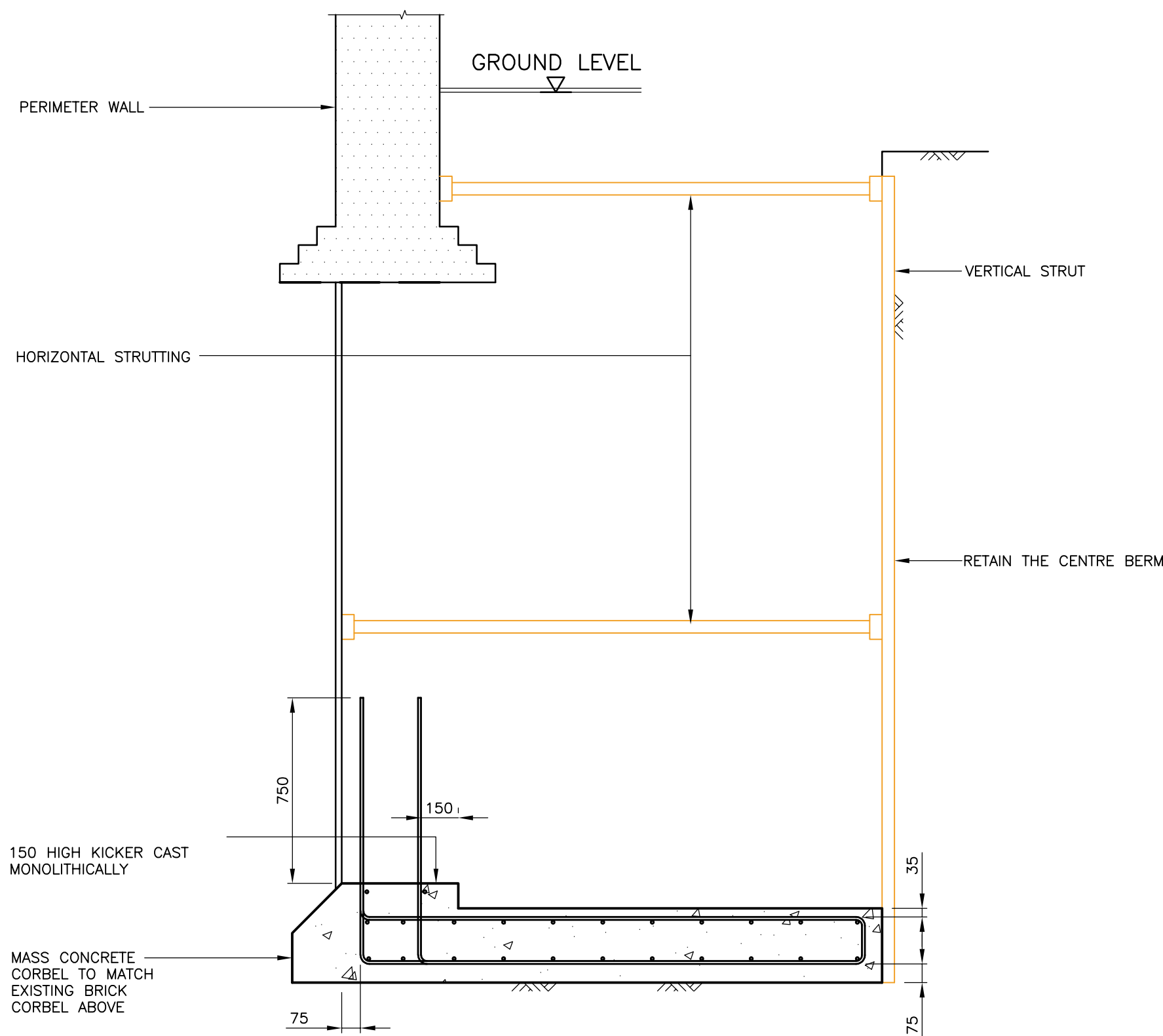


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Preliminary sequence of works
Issued for planning
Garage site on Ferrestone Road
SB
19.01.2023

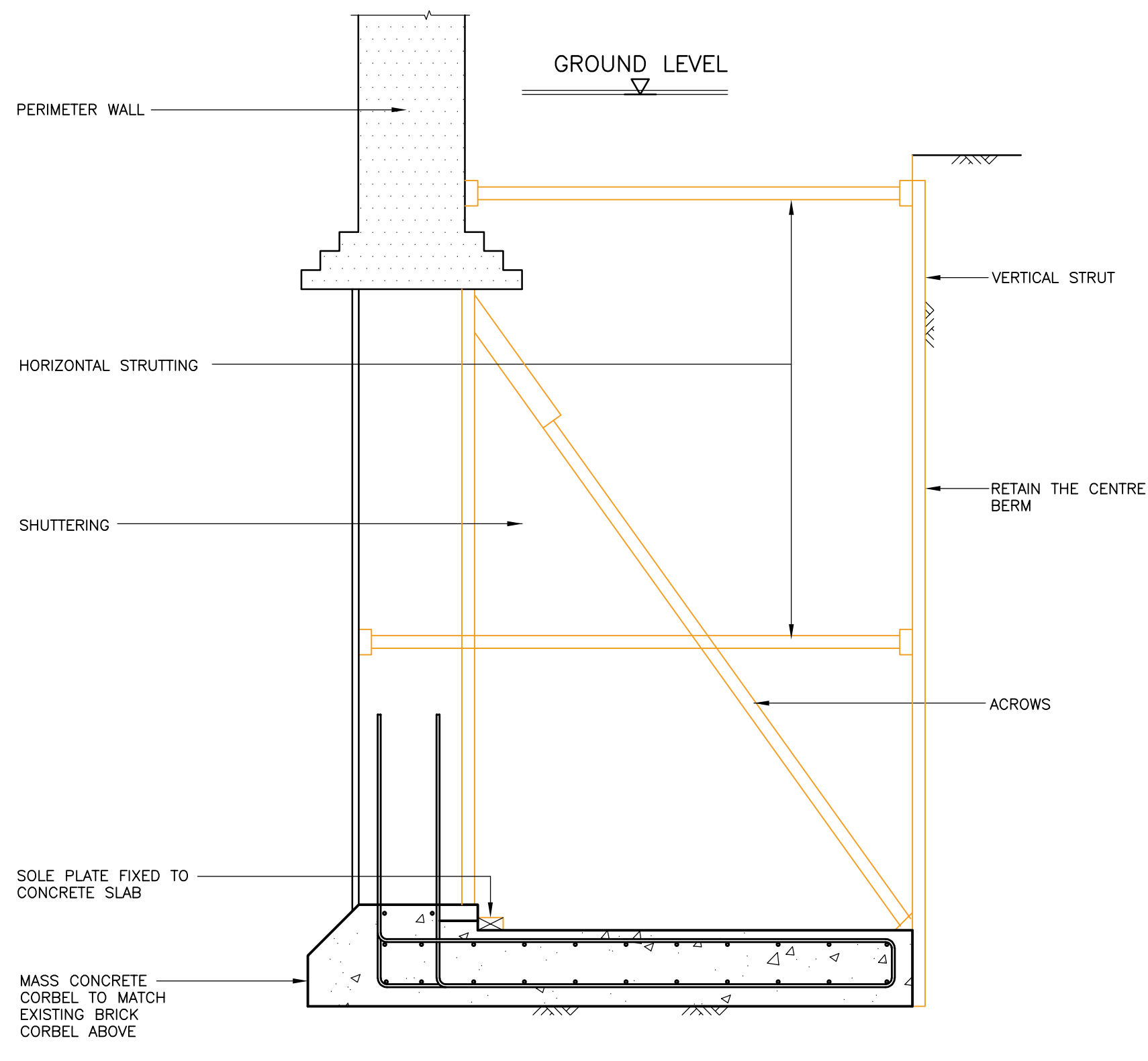
NOTE:
UNDERPINS TO BE DOWELLED INTO EACH OTHER WITH 6No. MIN H20 DOWELS WITH 400mm MIN. EMBEDMENT



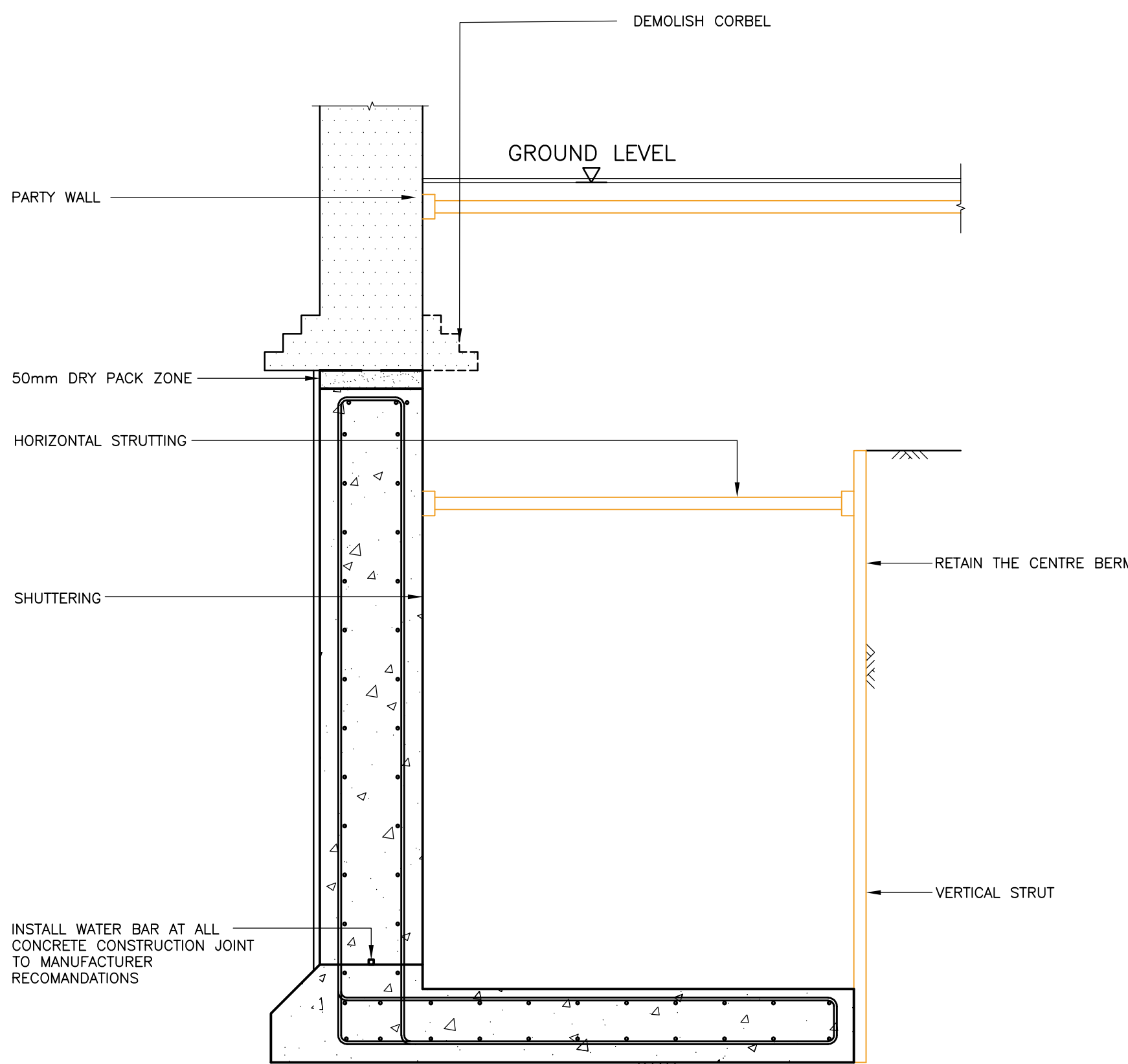
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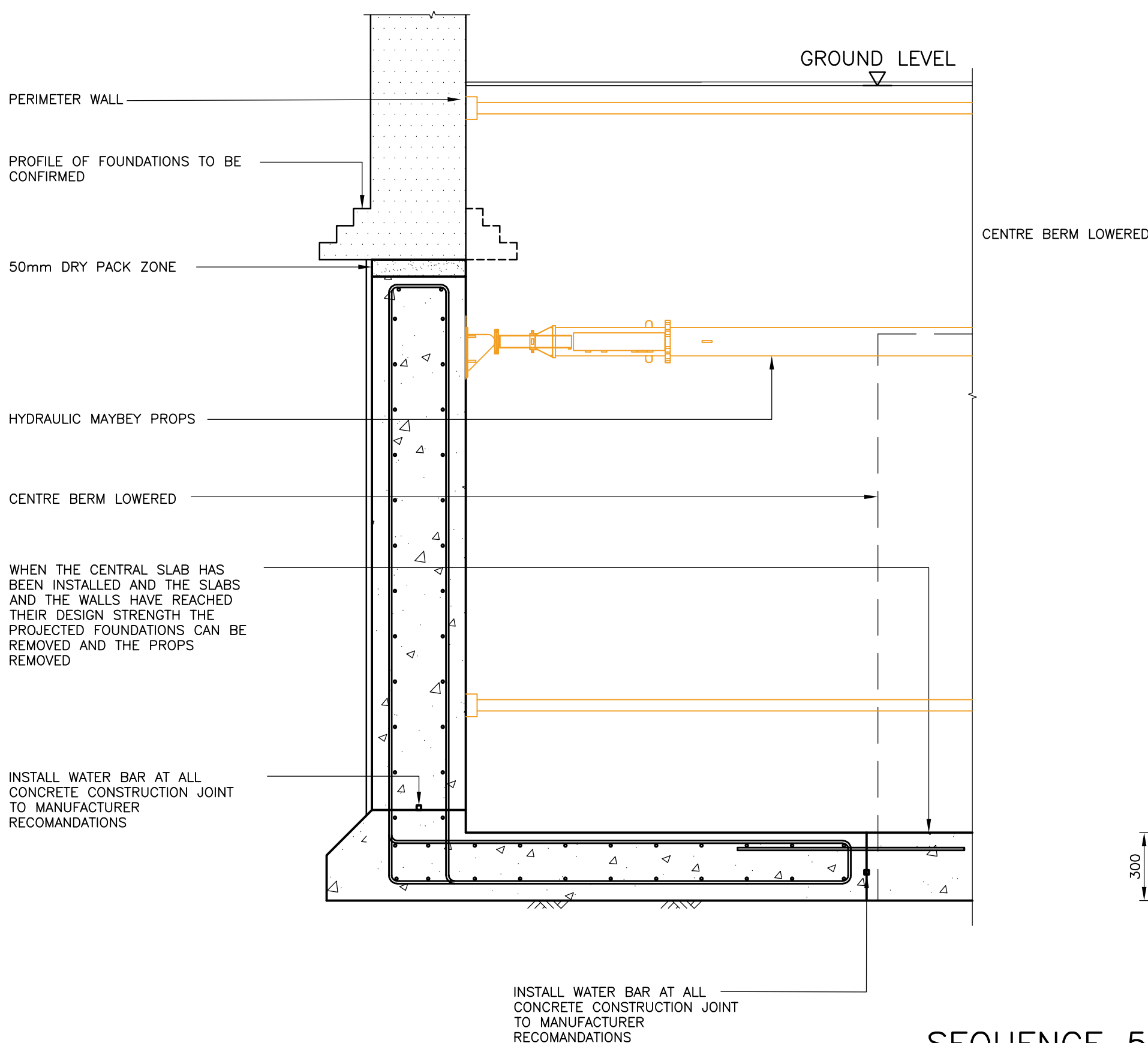
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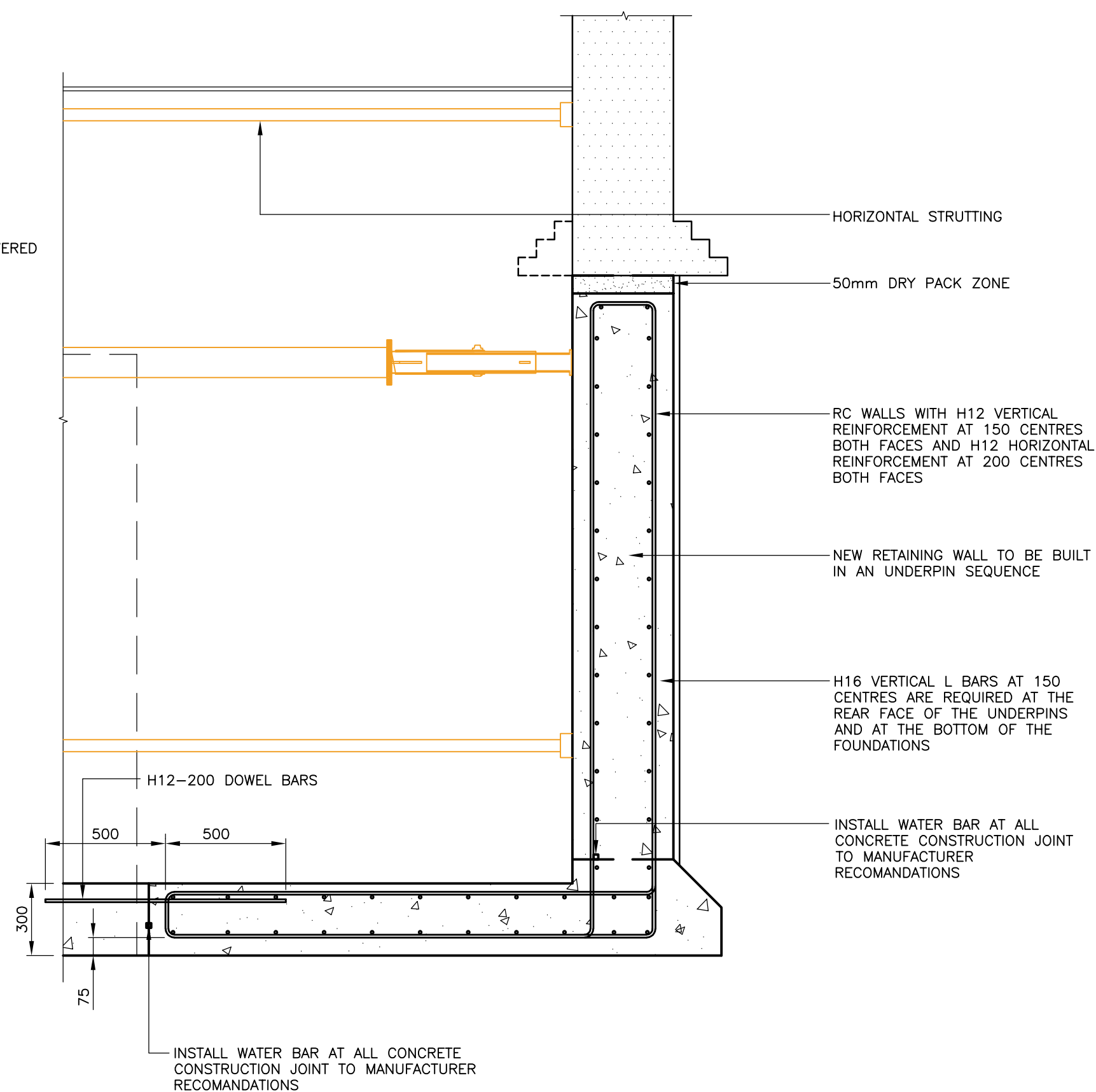
SEQUENCE 3



SEQUENCE 4



SEQUENCE 5



Notes

- This drawing is to be read in conjunction with all relevant Architects & Engineers drawings and specifications
- Do not scale from this drawing

Key to Health & Safety Symbols

- Warning risk indicates a residual risk as a warning.
- Compulsory risk indicates a residual risk requiring a compulsory action.
- Prohibitive risk indicates a residual risk requiring a prohibitive action.
- Information risk indicates a residual risk for information.

FOUNDATIONS

- ALL FOUNDATIONS TO BEAR ON GRAVEL/CLAY STRATA MINIMUM DEPTH 1000mm. ALLOWABLE BEARING PRESSURE REQUIRED 100kN/m²
- ALL CONCRETE TO BE GRADE C25 UNLESS OTHERWISE STATED (30N/mm² MINIMUM)
- BLINDING TO BE GRADE C25 CONCRETE DOWN TO BEARING STRATA (MINIMUM 50mm)
- SOFT SPOTS ENCOUNTERED IN SUBGRADE TO BE REMOVED AND FILLED IN LAYERS NOT GREATER THAN 300mm. FILL MATERIAL TO BE INERT GRADED GRANULAR MATERIALS OF MAXIMUM SIZE 25mm
- ALL EXCAVATIONS TO BE CLEANED AND APPROVED BY ENGINEER AND BUILDING CONTROL OFFICER ON SITE PRIOR TO CONCRETING OR BLINDING
- MAXIMUM AGGREGATES SIZES AS FOLLOWS
 - BLINDING AND MASS CONCRETE - 20mm

UNDERPINNING

- DRY PACK GROUT UNDERPINNING TO BE TO THE FOLLOWING SPECIFICATION:
 - MIX TO BE 3:1 OF SHARP SAND O.P.C.
 - SAND TO BE SHARPEST THAT CAN BE HANDLED
 - WATER CONTENT TO BE JUST ENOUGH TO ALLOW BALLING WHEN COMPRESSED BY HAND
- EXCAVATION FOR NEW FOUNDATIONS TO BE CARRIED OUT IN MAXIMUM 1.0m LENGTHS WITH A MINIMUM CLEAR SPACE OF 3.6m BETWEEN OPEN EXCAVATIONS AT ANY ONE TIME
- "OVER-DIG" FOR ACCESS PURPOSE IS ONLY PERMITTED IN THE DIRECTION AWAY FROM THE EXISTING BUILDING. ADDITIONAL EXCAVATION OF ANY KIND WHICH MAY UNDERMINE THE EXISTING FOUNDATIONS IS STRICTLY FORBIDDEN DURING UNDERPINNING OPERATIONS
- UNDERSIDE OF EXISTING FOUNDATIONS TO BE UNDERPINNED SHALL BE THOROUGHLY CLEANED TO EXPOSE SOUND CONCRETE/BRICKWORK
- NEW FOUNDATIONS TO BE CONCRETED/BRICKED UP TO WITHIN 75mm OF UNDERSIDE OF THE EXISTING FOUNDATION (50mm ABSOLUTE MINIMUM CLEAR)
- AFTER A MINIMUM CURING PERIOD OF 24 HOURS, THE 75mm GAP IS TO BE PINNED BY HAND OR MACHINE RAMMED OF DRY PACK GROUT
- SUBSEQUENT EXCAVATIONS CANNOT COMMENCE FOR A MINIMUM OF 48 HOURS AFTER PINNING
- CONTRACTORS METHOD STATEMENT AND PROGRAMME IS TO BE ISSUED AND APPROVED PRIOR TO WORKS COMMENCING ON SITE
- UNDERPINS TO BE CONNECTED WITH 4No. H20 BARS

P1 | 13.09.22 | SB | AB | ISSUED FOR PLANNING

Rev | Date | Drwn | Chkd | Amendments

Drawing Status PRELIMINARY



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Job Title

Garage on Ferrestone Road, London N8 7BX

Drawing Title

Typical underpinning sequence

Project Company Zones Level Type Role Number

22135- SYM - XX - 01 - DR - S - 0200

Scale: 1:20 AT A1

Date: Sept 2022

Drawn By: SB

Checked By: AB

Revision: P1

APPENDIX B

STRUCTURAL CALCULATIONS

WE ARE SYMMETRYS

STRUCTURAL CALCULATION PACKAGE (BIA)

GARAGE ON FERRESTONE ROAD
LONDON N8 7BX

22135-SYM-XX-XX-SC-S-0001 A





Revision History

Revision	Description	Date	By	Checked
P1	Preliminary Issue	21.09.22	SB	AB
A	First issue	19.01.23	SB	AB



1.0 Introduction

1.1 Symmetrys were instructed by Appleton Weiner Architects to undertake the structural design in support of the planning application for a proposed three storey building over 1-storey basement at a garage site on Ferrestone Road, N8 7BX, in the London Borough of Haringey.

1.2 The structural design works shall consist of the following:

- Design of the substructure of a 1-storey basement

2.0 Design Codes

2.1 The following design codes were used to carry out the design:

- BS EN 1990 – Basis of Structural design;
- BS EN 1991 – Actions on Structure;
- BS EN 1992 – Design of Concrete Structures;
- BS EN 1993 – Design of steel structures;
- BS EN 1997 – Geotechnical design.

3.0 Ground conditions

3.1 A Phase 2 site investigation has been carried out by LMB Geosolution LTD, confirming Made Ground to a depth of 1m overlaying London Clay.

4.0 Substructure design

4.1 An allowable net bearing pressure of 115kN/m² has been considered for design purposes, based on the value provided by LMB Geosolutions LTD (refer to “Ground investigation and assessment” report, issued in September 2022).

4.2 The following design parameters have been considered for the purpose of the substructure element design.

Strata	Depth Range (m bgl)		Effective Angle of Shear Resistance ⁽²⁾	Coefficient of Active Earth Pressure (K _a) ⁽²⁾	Coefficient of Passive Earth Resistance (K _p) ⁽²⁾	Bulk Density
	Top	Base				
Made Ground	Ground Level	0.44 – 1.00	27	0.35	3.5	1.70 ⁽¹⁾
Possible Head Deposits	0.44 – 1.00	1.10	22	0.37	3.0	1.80 ⁽¹⁾
London Clay	1.10	10.00	22	0.42	2.7	1.83 – 2.35 ⁽³⁾

(1) Assumed value based on literature information.

(2) Based on soil properties and reference to BS8002 & Tomlinson, M.J. (1986) for a free standing wall.

(3) Literature values taken from Forster (1997)

Figure 1. Table including design parameters to assist the design of retaining walls. Source: Ground Investigation & Assessment, LMB Geosolution LTD.

4.3 The total uplift due to soil heave and water pressure would be 60 kN/m² (see LMB Geosolutions LTD report). It has been advised that almost half of the uplift will be immediate upon excavation. Therefore, an uplift pressure of 40kN/m² have been considered for design purposes, equal to two third of the total uplift



5.0 Superstructure design

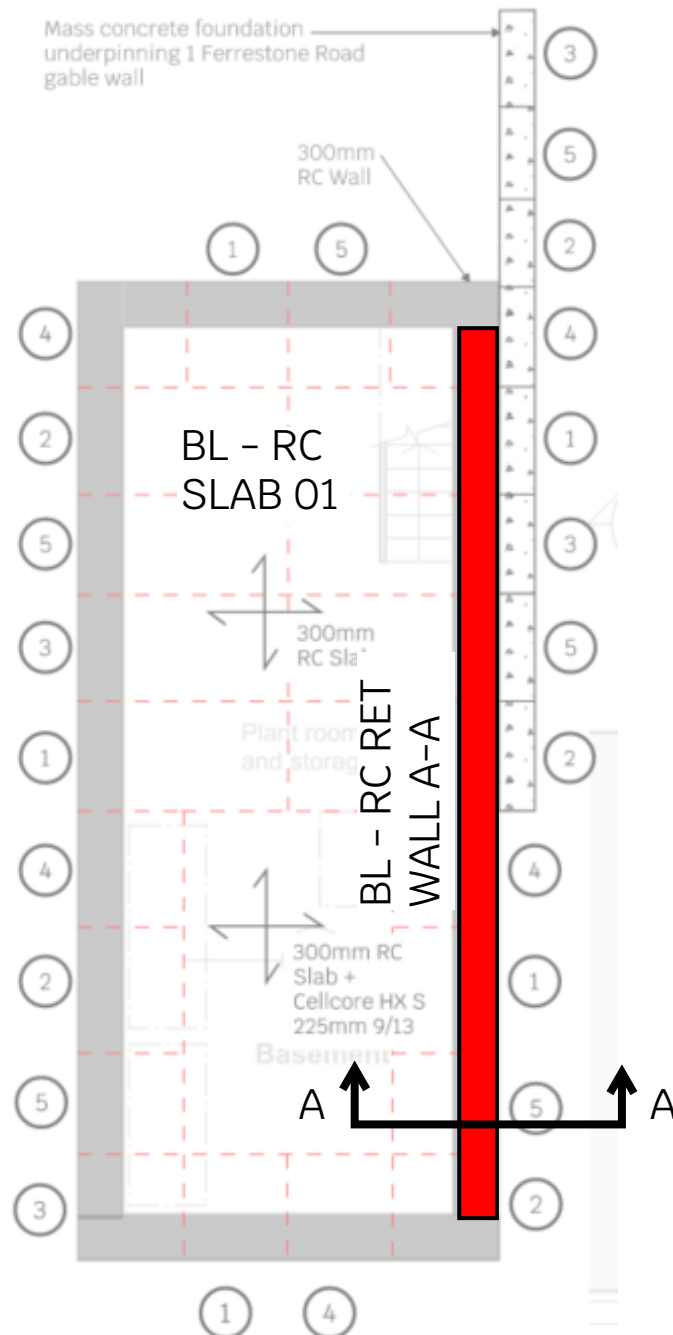
5.1 A schematic design of the superstructure has been developed to establish the load paths required for the substructure design. The design of the superstructure elements is not included in this report.

6.0 Loadings

Item	DL (kPa)	LL (kPa)
Timber Floor		
Ceiling and services	0.15	
Joists	0.2	
Plyboard and finishes	0.25	
Partition (self-weight assumed >1<2KN/m – EC1, 6.3.1.2 (8))		0.5
Imposed load		1.5
Total	0.6	2.0
Timber roof		
Ceiling and services	0.2	
Joists	0.2	
Plyboard and finishes	0.3	
Insulation	0.2	
Imposed load		0.6
Total dead load	0.9	
Cavity wall		
Finishes and insulation	0.3	
100mm medium-dense blockwork	1.5	
102.5mm masonry brickwork	2.0	
Total	3.8	
Ground floor level (area above basement)		
Finishes	2.0	
Ceiling	0.2	
250mm RC slab	6.3	
Partition (self-weight assumed >1<2KN/m – EC1, 6.3.1.2 (8))		0.5
Imposed load		1.5
Total	8.5	2.0
Ground floor level (garage area)		
Finishes	2.0	
Ceiling	0.2	
250mm RC slab	6.3	
Imposed load (NA to EC1, Table NA.6, Cat. F)		2.5
Total	8.5	
Basement floor level		
Finishes	2.0	
300mm RC slab	7.5	
Imposed load		1.5
Total	8.5	1.5
Existing masonry	19*	
Reinforced concrete	25*	
Note: * = KN/m3		



7.0 Structural elements reference plan and calculations





Job Title	GARAGE ON FERRESTONE ROAD, LONDON	Job No.	Sheet No.	Revision
		22135		
Section	LOAD TAKE DOWN - RET WALL A-A CHECK	Date	Made by	Checked by
		13.09.22	SB	AB

Introduction

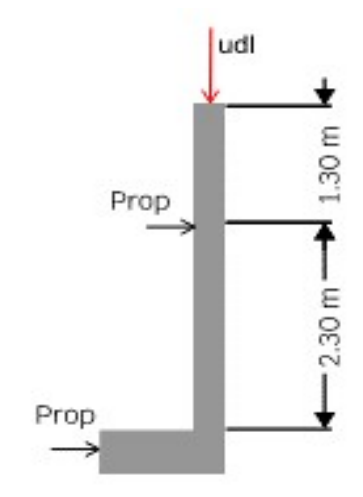
Based on the preliminary superstructure arrangement envisaged for the proposed building, the roof and floors loadings are assumed to be transferred to the foundations by steel frames, exerting permanent and variable uniformly distributed loadings to the basement retaining walls below the building flank walls.

Derivation of loadings (characteristic) for retaining wall design purposes (Section A-A)

Floor	Loadings per sq m		Span (m)	Total uniformly distributed load (udl) per floor	
	DL	LL		DL	LL
Roof	0.9	0.6	1.7	1.5	1.0
Second floor	0.6	2.0	1.7	1.0	3.4
First floor	0.6	2.0	1.7	1.0	3.4
Ground floor	8.5	2.0	1.7	14.5	3.4

Wall	Loadings per sq m		Height (m)	Total udl	
	DL	LL		DL	LL
Cavity wall	3.8	0.0	6.8	25.8	0.0

	DL	LL
Total udl	43.9	11.2





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RETAINING WALL ANALYSIS

In accordance with EN1997-1:2004 incorporating Corrigendum dated February 2009 and the UK National Annex incorporating Corrigendum No.1

Tedds calculation version 2.9.16

Retaining wall details

Stem type	Propped cantilever
Stem height	$h_{\text{stem}} = 3600 \text{ mm}$
Prop height	$h_{\text{prop}} = 2300 \text{ mm}$
Stem thickness	$t_{\text{stem}} = 300 \text{ mm}$
Angle to rear face of stem	$\alpha = 90 \text{ deg}$
Stem density	$\gamma_{\text{stem}} = 25 \text{ kN/m}^3$
Toe length	$l_{\text{toe}} = 1550 \text{ mm}$
Base thickness	$t_{\text{base}} = 300 \text{ mm}$
Base density	$\gamma_{\text{base}} = 25 \text{ kN/m}^3$
Height of retained soil	$h_{\text{ret}} = 3600 \text{ mm}$
Angle of soil surface	$\beta = 0 \text{ deg}$
Depth of cover	$d_{\text{cover}} = 0 \text{ mm}$
Height of water	$h_{\text{water}} = 2600 \text{ mm}$
Water density	$\gamma_w = 9.8 \text{ kN/m}^3$

Retained soil properties

Soil type	Firm clay
Moist density	$\gamma_{\text{mr}} = 18 \text{ kN/m}^3$
Saturated density	$\gamma_{\text{sr}} = 18 \text{ kN/m}^3$
Characteristic effective shear resistance angle	$\phi'_{\text{r,k}} = 22 \text{ deg}$
Characteristic wall friction angle	$\delta_{\text{r,k}} = 11 \text{ deg}$

Base soil properties

Soil type	Firm clay
Soil density	$\gamma_b = 18 \text{ kN/m}^3$
Characteristic effective shear resistance angle	$\phi'_{\text{b,k}} = 22 \text{ deg}$
Characteristic wall friction angle	$\delta_{\text{b,k}} = 11 \text{ deg}$
Characteristic base friction angle	$\delta_{\text{bb,k}} = 14.7 \text{ deg}$
Presumed bearing capacity	$P_{\text{bearing}} = 115 \text{ kN/m}^2$

Loading details

Vertical line load at 1700 mm	$P_{\text{G1}} = 43.9 \text{ kN/m}$
	$P_{\text{Q1}} = 11.2 \text{ kN/m}$



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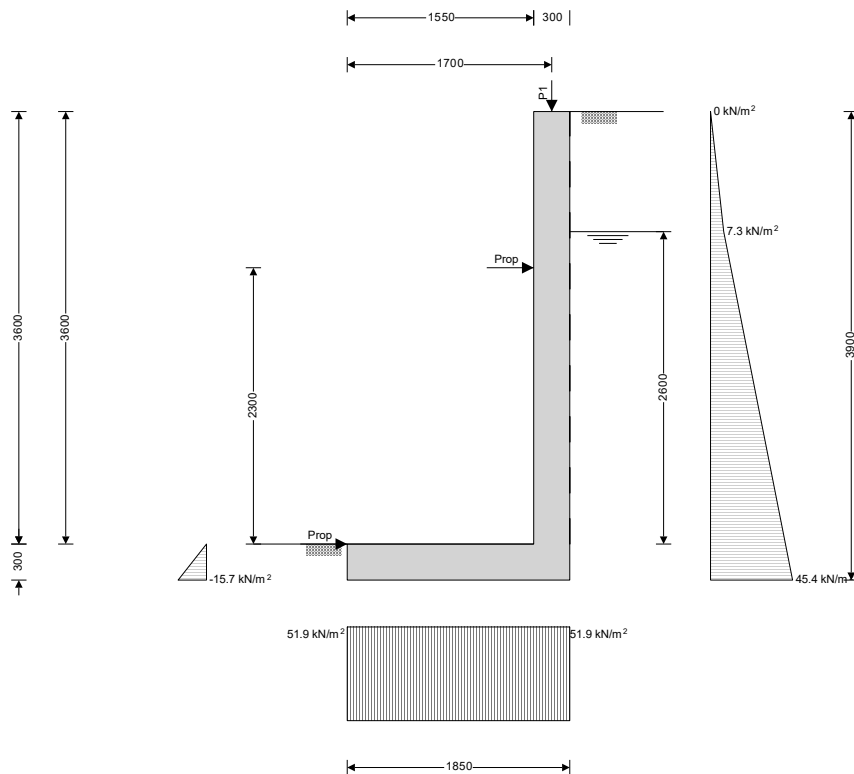
AB

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General arrangement - sketch pressures relate to bearing check

Calculate retaining wall geometry

Base length

$$l_{\text{base}} = l_{\text{toe}} + t_{\text{stem}} = \mathbf{1850 \text{ mm}}$$

Saturated soil height

$$h_{\text{sat}} = h_{\text{water}} + d_{\text{cover}} = \mathbf{2600 \text{ mm}}$$

Moist soil height

$$h_{\text{moist}} = h_{\text{ret}} - h_{\text{water}} = \mathbf{1000 \text{ mm}}$$

Retained surface length

$$l_{\text{sur}} = l_{\text{heel}} = \mathbf{0 \text{ mm}}$$

Effective height of wall

$$h_{\text{eff}} = h_{\text{base}} + d_{\text{cover}} + h_{\text{ret}} = \mathbf{3900 \text{ mm}}$$

Area of wall stem

$$A_{\text{stem}} = h_{\text{stem}} \times t_{\text{stem}} = \mathbf{1.08 \text{ m}^2}$$

- Distance to vertical component

$$x_{\text{stem}} = l_{\text{toe}} + t_{\text{stem}} / 2 = \mathbf{1700 \text{ mm}}$$

Area of wall base

$$A_{\text{base}} = l_{\text{base}} \times t_{\text{base}} = \mathbf{0.555 \text{ m}^2}$$

- Distance to vertical component

$$x_{\text{base}} = l_{\text{base}} / 2 = \mathbf{925 \text{ mm}}$$

Using Coulomb theory

Active pressure coefficient

$$K_A = \frac{\sin(\alpha + \phi'_{r,k})^2}{(\sin(\alpha)^2 \times \sin(\alpha - \delta_{r,k}) \times [1 + \sqrt{[\sin(\phi'_{r,k} + \delta_{r,k}) \times \sin(\phi'_{r,k} - \beta)] / (\sin(\alpha - \delta_{r,k}) \times \sin(\alpha + \beta))}]^2)} = \mathbf{0.413}$$

Passive pressure coefficient

$$K_P = \frac{\sin(90 - \phi'_{b,k})^2}{(\sin(90 + \delta_{b,k}) \times [1 - \sqrt{[\sin(\phi'_{b,k} + \delta_{b,k}) \times \sin(\phi'_{b,k} - \beta)] / (\sin(90 + \delta_{b,k}))}]^2)} = \mathbf{2.958}$$

Bearing pressure check

Vertical forces on wall

Wall stem

$$F_{\text{stem}} = A_{\text{stem}} \times \gamma_{\text{stem}} = \mathbf{27 \text{ kN/m}}$$

Wall base

$$F_{\text{base}} = A_{\text{base}} \times \gamma_{\text{base}} = \mathbf{13.9 \text{ kN/m}}$$

Line loads

$$F_{P_v} = P_{G1} + P_{Q1} = \mathbf{55.1 \text{ kN/m}}$$

Total

$$F_{\text{total}_v} = F_{\text{stem}} + F_{\text{base}} + F_{P_v} + F_{\text{water}_v} = \mathbf{96 \text{ kN/m}}$$



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Horizontal forces on wall

Saturated retained soil

$$F_{\text{sat}_h} = K_A \times \cos(\delta_{r,k}) \times (\gamma_{sr} - \gamma_w) \times (h_{\text{sat}} + h_{\text{base}})^2 / 2 = 14 \text{ kN/m}$$

Water

$$F_{\text{water}_h} = \gamma_w \times (h_{\text{water}} + d_{\text{cover}} + h_{\text{base}})^2 / 2 = 41.3 \text{ kN/m}$$

Moist retained soil

$$F_{\text{moist}_h} = K_A \times \cos(\delta_{r,k}) \times \gamma_{mr} \times ((h_{\text{eff}} - h_{\text{sat}} - h_{\text{base}})^2 / 2 + (h_{\text{eff}} - h_{\text{sat}} - h_{\text{base}}) \times (h_{\text{sat}} + h_{\text{base}})) = 24.8 \text{ kN/m}$$

Base soil

$$F_{\text{pass}_h} = -K_P \times \cos(\delta_{b,k}) \times \gamma_b \times (d_{\text{cover}} + h_{\text{base}})^2 / 2 = -2.4 \text{ kN/m}$$

Total

$$F_{\text{total}_h} = F_{\text{sat}_h} + F_{\text{water}_h} + F_{\text{moist}_h} + F_{\text{pass}_h} = 77.7 \text{ kN/m}$$

Moments on wall

Wall stem

$$M_{\text{stem}} = F_{\text{stem}} \times x_{\text{stem}} = 45.9 \text{ kNm/m}$$

Wall base

$$M_{\text{base}} = F_{\text{base}} \times x_{\text{base}} = 12.8 \text{ kNm/m}$$

Line loads

$$M_P = (P_{G1} + P_{Q1}) \times p_1 = 93.7 \text{ kNm/m}$$

Saturated retained soil

$$M_{\text{sat}} = -F_{\text{sat}_h} \times x_{\text{sat}_h} = -13.5 \text{ kNm/m}$$

Water

$$M_{\text{water}} = -F_{\text{water}_h} \times x_{\text{water}_h} = -39.9 \text{ kNm/m}$$

Moist retained soil

$$M_{\text{moist}} = -F_{\text{moist}_h} \times x_{\text{moist}_h} = -42.5 \text{ kNm/m}$$

Total

$$M_{\text{total}} = M_{\text{stem}} + M_{\text{base}} + M_P + M_{\text{sat}} + M_{\text{water}} + M_{\text{moist}} = 56.5 \text{ kNm/m}$$

Check bearing pressure

Propping force to stem

$$F_{\text{prop}_\text{stem}} = (F_{\text{total}_v} \times l_{\text{base}} / 2 - M_{\text{total}}) / (h_{\text{prop}} + t_{\text{base}}) = 12.4 \text{ kN/m}$$

Propping force to base

$$F_{\text{prop}_\text{base}} = F_{\text{total}_h} - F_{\text{prop}_\text{stem}} = 65.3 \text{ kN/m}$$

Moment from propping force

$$M_{\text{prop}} = F_{\text{prop}_\text{stem}} \times (h_{\text{prop}} + t_{\text{base}}) = 32.3 \text{ kNm/m}$$

Distance to reaction

$$\bar{x} = (M_{\text{total}} + M_{\text{prop}}) / F_{\text{total}_v} = 925 \text{ mm}$$

Eccentricity of reaction

$$e = \bar{x} - l_{\text{base}} / 2 = 0 \text{ mm}$$

Loaded length of base

$$l_{\text{load}} = l_{\text{base}} = 1850 \text{ mm}$$

Bearing pressure at toe

$$q_{\text{toe}} = F_{\text{total}_v} / l_{\text{base}} \times (1 - 6 \times e / l_{\text{base}}) = 51.9 \text{ kN/m}^2$$

Bearing pressure at heel

$$q_{\text{heel}} = F_{\text{total}_v} / l_{\text{base}} \times (1 + 6 \times e / l_{\text{base}}) = 51.9 \text{ kN/m}^2$$

Factor of safety

$$FoS_{bp} = P_{\text{bearing}} / \max(q_{\text{toe}}, q_{\text{heel}}) = 2.217$$

PASS - Allowable bearing pressure exceeds maximum applied bearing pressure

RETAINING WALL DESIGN

In accordance with EN1992-1-1:2004 incorporating Corrigendum dated January 2008 and the UK National Annex incorporating National Amendment No.1

Tedds calculation version 2.9.16

Concrete details - Table 3.1 - Strength and deformation characteristics for concrete

Concrete strength class

$$C30/37$$

Characteristic compressive cylinder strength

$$f_{ck} = 30 \text{ N/mm}^2$$

Characteristic compressive cube strength

$$f_{ck, \text{cube}} = 37 \text{ N/mm}^2$$

Mean value of compressive cylinder strength

$$f_{cm} = f_{ck} + 8 \text{ N/mm}^2 = 38 \text{ N/mm}^2$$

Mean value of axial tensile strength

$$f_{ctm} = 0.3 \text{ N/mm}^2 \times (f_{ck} / 1 \text{ N/mm}^2)^{2/3} = 2.9 \text{ N/mm}^2$$

5% fractile of axial tensile strength

$$f_{ctk, 0.05} = 0.7 \times f_{ctm} = 2.0 \text{ N/mm}^2$$

Secant modulus of elasticity of concrete

$$E_{cm} = 22 \text{ kN/mm}^2 \times (f_{cm} / 10 \text{ N/mm}^2)^{0.3} = 32837 \text{ N/mm}^2$$

Partial factor for concrete - Table 2.1N

$$\gamma_C = 1.50$$

Compressive strength coefficient - cl.3.1.6(1)

$$\alpha_{cc} = 0.85$$

Design compressive concrete strength - exp.3.15

$$f_{cd} = \alpha_{cc} \times f_{ck} / \gamma_C = 17.0 \text{ N/mm}^2$$

Maximum aggregate size

$$h_{agg} = 20 \text{ mm}$$

Ultimate strain - Table 3.1

$$\epsilon_{cu2} = 0.0035$$

Shortening strain - Table 3.1

$$\epsilon_{cu3} = 0.0035$$



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Effective compression zone height factor

$\lambda = 0.80$

Effective strength factor

$\eta = 1.00$

Bending coefficient k_1

$K_1 = 0.40$

Bending coefficient k_2

$K_2 = 1.00 \times (0.6 + 0.0014/\epsilon_{cu2}) = 1.00$

Bending coefficient k_3

$K_3 = 0.40$

Bending coefficient k_4

$K_4 = 1.00 \times (0.6 + 0.0014/\epsilon_{cu2}) = 1.00$

Reinforcement details

Characteristic yield strength of reinforcement

$f_{yk} = 500 \text{ N/mm}^2$

Modulus of elasticity of reinforcement

$E_s = 200000 \text{ N/mm}^2$

Partial factor for reinforcing steel - Table 2.1N

$\gamma_s = 1.15$

Design yield strength of reinforcement

$f_{yd} = f_{yk} / \gamma_s = 435 \text{ N/mm}^2$

Cover to reinforcement

Front face of stem

$c_{sf} = 40 \text{ mm}$

Rear face of stem

$c_{sr} = 50 \text{ mm}$

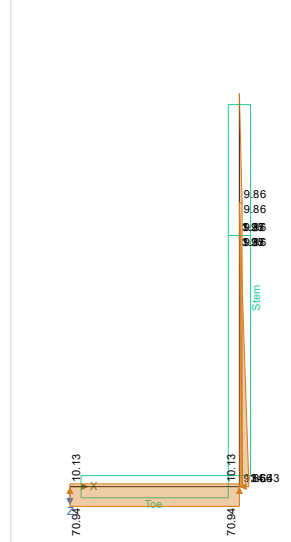
Top face of base

$c_{bt} = 50 \text{ mm}$

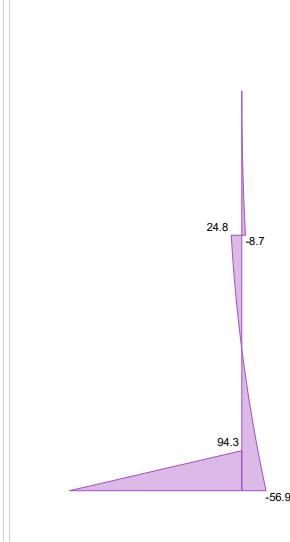
Bottom face of base

$c_{bb} = 75 \text{ mm}$

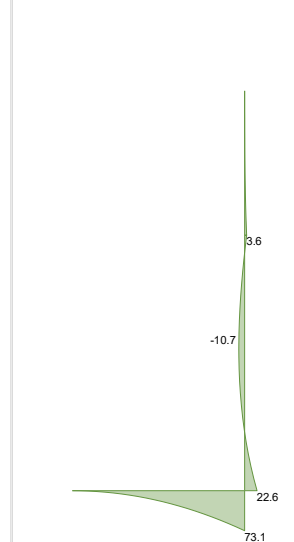
Loading details - Combination No.1 - kN/m²



Shear force - Combination No.1 - kN/m



Bending moment - Combination No.1 - kNm/m



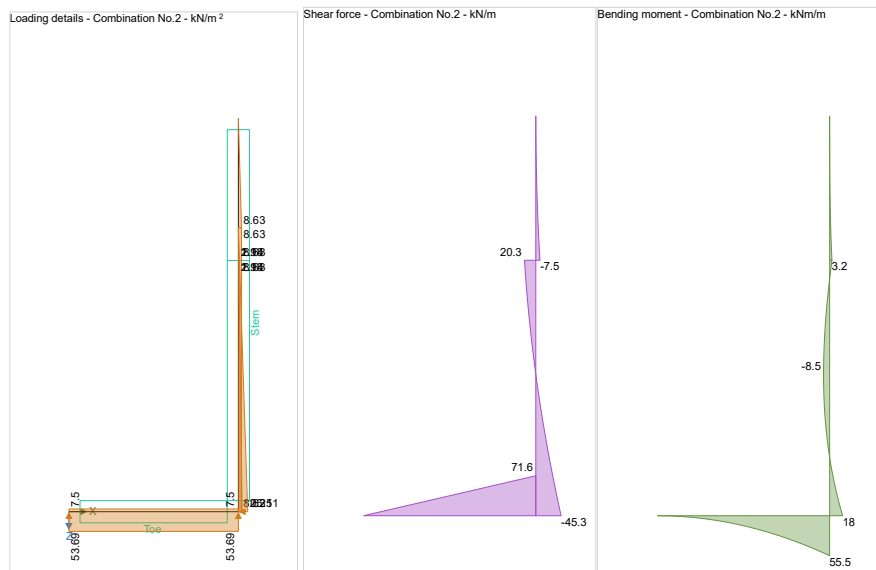


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Check stem design at 1126 mm

Depth of section

$h = 300 \text{ mm}$

Rectangular section in flexure - Section 6.1

Design bending moment combination 1

$M = 10.7 \text{ kNm/m}$

Depth to tension reinforcement

$d = h - c_{sf} - \phi_{sx} - \phi_{sfM} / 2 = 242 \text{ mm}$

$K = M / (d^2 \times f_{ck}) = 0.006$

$K' = (2 \times \eta \times \alpha_{cc} / \gamma_c) \times (1 - \lambda \times (\delta - K_1) / (2 \times K_2)) \times (\lambda \times (\delta - K_1) / (2 \times K_2))$

$K' = 0.207$

$K' > K$ - No compression reinforcement is required

Lever arm

$z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_c))^{0.5}, 0.95) \times d = 230 \text{ mm}$

Depth of neutral axis

$x = 2.5 \times (d - z) = 30 \text{ mm}$

Area of tension reinforcement required

$A_{sfM,req} = M / (f_{yd} \times z) = 107 \text{ mm}^2/\text{m}$

Tension reinforcement provided

16 dia.bars @ 150 c/c

Area of tension reinforcement provided

$A_{sfM,prov} = \pi \times \phi_{sfM}^2 / (4 \times s_{sfM}) = 1340 \text{ mm}^2/\text{m}$

Minimum area of reinforcement - exp.9.1N

$A_{sfM,min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d = 364 \text{ mm}^2/\text{m}$

Maximum area of reinforcement - cl.9.2.1.1(3)

$A_{sfM,max} = 0.04 \times h = 12000 \text{ mm}^2/\text{m}$

$\max(A_{sfM,req}, A_{sfM,min}) / A_{sfM,prov} = 0.272$

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio

$\rho_0 = \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} / 1000 = 0.005$

Required tension reinforcement ratio

$\rho = A_{sfM,req} / d = 0.000$

Required compression reinforcement ratio

$\rho' = A_{sfM,2,req} / d_2 = 0.000$

Structural system factor - Table 7.4N

$K_b = 1$

Reinforcement factor - exp.7.17

$K_s = \min(500 \text{ N/mm}^2 / (f_{yk} \times A_{sfM,req} / A_{sfM,prov}), 1.5) = 1.5$

Limiting span to depth ratio - exp.7.16.a

$\min(K_s \times K_b \times [11 + 1.5 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times \rho_0 / \rho + 3.2 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times (\rho_0 / \rho - 1)^{3/2}], 40 \times K_b) = 40$

Actual span to depth ratio

$h_{prop} / d = 9.5$

PASS - Span to depth ratio is less than deflection control limit



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Crack control - Section 7.3

Limiting crack width

$$w_{max} = 0.3 \text{ mm}$$

Variable load factor - EN1990 – Table A1.1

$$\psi_2 = 0.6$$

Serviceability bending moment

$$M_{sls} = 7.9 \text{ kNm/m}$$

Tensile stress in reinforcement

$$\sigma_s = M_{sls} / (A_{sfM,prov} \times z) = 25.6 \text{ N/mm}^2$$

Load duration

Long term

Load duration factor

$$k_t = 0.4$$

Effective area of concrete in tension

$$A_{c,eff} = \min(2.5 \times (h - d), (h - x) / 3, h / 2)$$

$$A_{c,eff} = 89917 \text{ mm}^2/\text{m}$$

Mean value of concrete tensile strength

$$f_{ct,eff} = f_{ctm} = 2.9 \text{ N/mm}^2$$

Reinforcement ratio

$$\rho_{p,eff} = A_{sfM,prov} / A_{c,eff} = 0.015$$

Modular ratio

$$\alpha_e = E_s / E_{cm} = 6.091$$

Bond property coefficient

$$k_1 = 0.8$$

Strain distribution coefficient

$$k_2 = 0.5$$

$$k_3 = 3.4$$

$$k_4 = 0.425$$

Maximum crack spacing - exp.7.11

$$s_{r,max} = k_3 \times c_{sf} + k_1 \times k_2 \times k_4 \times \phi_{sfM} / \rho_{p,eff} = 318 \text{ mm}$$

Maximum crack width - exp.7.8

$$w_k = s_{r,max} \times \max(\sigma_s - k_t \times (f_{ct,eff} / \rho_{p,eff}) \times (1 + \alpha_e \times \rho_{p,eff}), 0.6 \times \sigma_s) / E_s$$

$$w_k = 0.024 \text{ mm}$$

$$w_k / w_{max} = 0.082$$

PASS - Maximum crack width is less than limiting crack width

Check stem design at base of stem

Depth of section

$$h = 300 \text{ mm}$$

Rectangular section in flexure - Section 6.1

Design bending moment combination 1

$$M = 22.6 \text{ kNm/m}$$

Depth to tension reinforcement

$$d = h - c_{sr} - \phi_{sr} / 2 = 242 \text{ mm}$$

$$K = M / (d^2 \times f_{ck}) = 0.013$$

$$K' = (2 \times \eta \times \alpha_{cc} / \gamma_c) \times (1 - \lambda \times (\delta - K_1) / (2 \times K_2)) \times (\lambda \times (\delta - K_1) / (2 \times K_2))$$

$$K' = 0.207$$

K' > K - No compression reinforcement is required

Lever arm

$$z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_c))^{0.5}, 0.95) \times d = 230 \text{ mm}$$

Depth of neutral axis

$$x = 2.5 \times (d - z) = 30 \text{ mm}$$

Area of tension reinforcement required

$$A_{sr,req} = M / (f_{yd} \times z) = 226 \text{ mm}^2/\text{m}$$

Tension reinforcement provided

$$16 \text{ dia. bars @ } 150 \text{ c/c}$$

Area of tension reinforcement provided

$$A_{sr,prov} = \pi \times \phi_{sr}^2 / (4 \times s_{sr}) = 1340 \text{ mm}^2/\text{m}$$

Minimum area of reinforcement - exp.9.1N

$$A_{sr,min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d = 364 \text{ mm}^2/\text{m}$$

Maximum area of reinforcement - cl.9.2.1.1(3)

$$A_{sr,max} = 0.04 \times h = 12000 \text{ mm}^2/\text{m}$$

$$\max(A_{sr,req}, A_{sr,min}) / A_{sr,prov} = 0.272$$

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio

$$\rho_0 = \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} / 1000 = 0.005$$

Required tension reinforcement ratio

$$\rho = A_{sr,req} / d = 0.001$$

Required compression reinforcement ratio

$$\rho' = A_{sr,2,req} / d_2 = 0.000$$

Structural system factor - Table 7.4N

$$K_b = 1$$

Reinforcement factor - exp.7.17

$$K_s = \min(500 \text{ N/mm}^2 / (f_{yk} \times A_{sr,req} / A_{sr,prov}), 1.5) = 1.5$$



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Limiting span to depth ratio - exp.7.16.a

$$\min(K_s \times K_b \times [11 + 1.5 \times \sqrt{f_{ck} / 1 \text{ N/mm}^2}] \times \rho_0 / \rho + 3.2 \times \sqrt{f_{ck} / 1 \text{ N/mm}^2}) \times (\rho_0 / \rho - 1)^{3/2}, 40 \times K_b) = 40$$

Actual span to depth ratio

$$h_{prop} / d = 9.5$$

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width

$$w_{max} = 0.3 \text{ mm}$$

Variable load factor - EN1990 – Table A1.1

$$\psi_2 = 0.6$$

Serviceability bending moment

$$M_{sls} = 16.7 \text{ kNm/m}$$

Tensile stress in reinforcement

$$\sigma_s = M_{sls} / (A_{sr,prov} \times z) = 54.3 \text{ N/mm}^2$$

Load duration

Long term

Load duration factor

$$k_t = 0.4$$

Effective area of concrete in tension

$$A_{c,eff} = \min(2.5 \times (h - d), (h - x) / 3, h / 2)$$

$$A_{c,eff} = 89917 \text{ mm}^2/\text{m}$$

Mean value of concrete tensile strength

$$f_{ct,eff} = f_{ctm} = 2.9 \text{ N/mm}^2$$

Reinforcement ratio

$$\rho_{p,eff} = A_{sr,prov} / A_{c,eff} = 0.015$$

Modular ratio

$$\alpha_e = E_s / E_{cm} = 6.091$$

Bond property coefficient

$$k_1 = 0.8$$

Strain distribution coefficient

$$k_2 = 0.5$$

$$k_3 = 3.4$$

$$k_4 = 0.425$$

Maximum crack spacing - exp.7.11

$$s_{r,max} = k_3 \times c_{sr} + k_1 \times k_2 \times k_4 \times \phi_{sr} / \rho_{p,eff} = 352 \text{ mm}$$

Maximum crack width - exp.7.8

$$w_k = s_{r,max} \times \max(\sigma_s - k_t \times (f_{ct,eff} / \rho_{p,eff}) \times (1 + \alpha_e \times \rho_{p,eff}), 0.6 \times \sigma_s) / E_s$$

$$w_k = 0.057 \text{ mm}$$

$$w_k / w_{max} = 0.191$$

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force

$$V = 56.9 \text{ kN/m}$$

$$C_{Rd,c} = 0.18 / \gamma_c = 0.120$$

$$k = \min(1 + \sqrt{(200 \text{ mm} / d)}, 2) = 1.909$$

Longitudinal reinforcement ratio

$$\rho_l = \min(A_{sr,prov} / d, 0.02) = 0.006$$

$$v_{min} = 0.035 \text{ N}^{1/2}/\text{mm} \times k^{3/2} \times f_{ck}^{0.5} = 0.506 \text{ N/mm}^2$$

Design shear resistance - exp.6.2a & 6.2b

$$V_{Rd,c} = \max(C_{Rd,c} \times k \times (100 \text{ N}^2/\text{mm}^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$$

$$V_{Rd,c} = 141.5 \text{ kN/m}$$

$$V / V_{Rd,c} = 0.403$$

PASS - Design shear resistance exceeds design shear force

Check stem design at prop

Depth of section

$$h = 300 \text{ mm}$$

Rectangular section in flexure - Section 6.1

Design bending moment combination 1

$$M = 3.6 \text{ kNm/m}$$

Depth to tension reinforcement

$$d = h - c_{sr} - \phi_{sr1} / 2 = 242 \text{ mm}$$

$$K = M / (d^2 \times f_{ck}) = 0.002$$

$$K' = (2 \times \eta \times \alpha_{cc} / \gamma_c) \times (1 - \lambda \times (\delta - K_1) / (2 \times K_2)) \times (\lambda \times (\delta - K_1) / (2 \times K_2))$$

$$K' = 0.207$$

K' > K - No compression reinforcement is required

Lever arm

$$z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_c))^{0.5}, 0.95) \times d = 230 \text{ mm}$$



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Depth of neutral axis

$$x = 2.5 \times (d - z) = \mathbf{30 \text{ mm}}$$

Area of tension reinforcement required

$$A_{sr1.req} = M / (f_{yd} \times z) = \mathbf{36 \text{ mm}^2/\text{m}}$$

Tension reinforcement provided

16 dia.bars @ 150 c/c

Area of tension reinforcement provided

$$A_{sr1.prov} = \pi \times \phi_{sr1}^2 / (4 \times s_{sr1}) = \mathbf{1340 \text{ mm}^2/\text{m}}$$

Minimum area of reinforcement - exp.9.1N

$$A_{sr1.min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d = \mathbf{364 \text{ mm}^2/\text{m}}$$

Maximum area of reinforcement - cl.9.2.1.1(3)

$$A_{sr1.max} = 0.04 \times h = \mathbf{12000 \text{ mm}^2/\text{m}}$$

$$\max(A_{sr1.req}, A_{sr1.min}) / A_{sr1.prov} = \mathbf{0.272}$$

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Deflection control - Section 7.4

Reference reinforcement ratio

$$\rho_0 = \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} / 1000 = \mathbf{0.005}$$

Required tension reinforcement ratio

$$\rho = A_{sr1.req} / d = \mathbf{0.000}$$

Required compression reinforcement ratio

$$\rho' = A_{sr1.2.req} / d_2 = \mathbf{0.000}$$

Structural system factor - Table 7.4N

$$K_b = \mathbf{0.4}$$

Reinforcement factor - exp.7.17

$$K_s = \min(500 \text{ N/mm}^2 / (f_{yk} \times A_{sr1.req} / A_{sr1.prov}), 1.5) = \mathbf{1.5}$$

Limiting span to depth ratio - exp.7.16.a

$$\min(K_s \times K_b \times [1 + 1.5 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times \rho_0 / \rho + 3.2 \times \sqrt{(f_{ck} / 1 \text{ N/mm}^2)} \times (\rho_0 / \rho - 1)^{3/2}], 40 \times K_b) = \mathbf{16}$$

Actual span to depth ratio

$$(h_{stem} - h_{prop}) / d = \mathbf{5.4}$$

PASS - Span to depth ratio is less than deflection control limit

Crack control - Section 7.3

Limiting crack width

$$w_{max} = \mathbf{0.3 \text{ mm}}$$

Variable load factor - EN1990 – Table A1.1

$$\psi_2 = \mathbf{0.6}$$

Serviceability bending moment

$$M_{sls} = \mathbf{2.7 \text{ kNm/m}}$$

Tensile stress in reinforcement

$$\sigma_s = M_{sls} / (A_{sr1.prov} \times z) = \mathbf{8.8 \text{ N/mm}^2}$$

Load duration

Long term

Load duration factor

$$k_t = \mathbf{0.4}$$

Effective area of concrete in tension

$$A_{c,eff} = \min(2.5 \times (h - d), (h - x) / 3, h / 2)$$

$$A_{c,eff} = \mathbf{89917 \text{ mm}^2/\text{m}}$$

Mean value of concrete tensile strength

$$f_{ct,eff} = f_{ctm} = \mathbf{2.9 \text{ N/mm}^2}$$

Reinforcement ratio

$$\rho_{p,eff} = A_{sr1.prov} / A_{c,eff} = \mathbf{0.015}$$

Modular ratio

$$\alpha_e = E_s / E_{cm} = \mathbf{6.091}$$

Bond property coefficient

$$k_1 = \mathbf{0.8}$$

Strain distribution coefficient

$$k_2 = \mathbf{0.5}$$

$$k_3 = \mathbf{3.4}$$

$$k_4 = \mathbf{0.425}$$

Maximum crack spacing - exp.7.11

$$s_{r,max} = k_3 \times c_{sr} + k_1 \times k_2 \times k_4 \times \phi_{sr1} / \rho_{p,eff} = \mathbf{352 \text{ mm}}$$

Maximum crack width - exp.7.8

$$w_k = s_{r,max} \times \max(\sigma_s - k_t \times (f_{ct,eff} / \rho_{p,eff}) \times (1 + \alpha_e \times \rho_{p,eff}), 0.6 \times \sigma_s) / E_s$$

$$w_k = \mathbf{0.009 \text{ mm}}$$

$$w_k / w_{max} = \mathbf{0.031}$$

PASS - Maximum crack width is less than limiting crack width

Rectangular section in shear - Section 6.2

Design shear force

$$V = \mathbf{24.8 \text{ kN/m}}$$

$$C_{Rd,c} = 0.18 / \gamma_c = \mathbf{0.120}$$

$$k = \min(1 + \sqrt{(200 \text{ mm} / d)}, 2) = \mathbf{1.909}$$

Longitudinal reinforcement ratio

$$\rho_l = \min(A_{sr1.prov} / d, 0.02) = \mathbf{0.006}$$

$$v_{min} = 0.035 \text{ N}^{1/2}/\text{mm} \times k^{3/2} \times f_{ck}^{0.5} = \mathbf{0.506 \text{ N/mm}^2}$$



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Design shear resistance - exp.6.2a & 6.2b

$$V_{Rd,c} = \max(C_{Rd,c} \times k \times (100 N^2/mm^4 \times \rho_l \times f_{ck})^{1/3}, v_{min}) \times d$$

$$V_{Rd,c} = 141.5 \text{ kN/m}$$

$$V / V_{Rd,c} = 0.176$$

PASS - Design shear resistance exceeds design shear force

Horizontal reinforcement parallel to face of stem - Section 9.6

Minimum area of reinforcement – cl.9.6.3(1)

$$A_{sx,req} = \max(0.25 \times A_{sr,prov}, 0.001 \times t_{stem}) = 335 \text{ mm}^2/m$$

Maximum spacing of reinforcement – cl.9.6.3(2)

$$s_{sx,max} = 400 \text{ mm}$$

Transverse reinforcement provided

$$10 \text{ dia.bars @ } 200 \text{ c/c}$$

Area of transverse reinforcement provided

$$A_{sx,prov} = \pi \times \phi_{sx}^2 / (4 \times s_{sx}) = 393 \text{ mm}^2/m$$

PASS - Area of reinforcement provided is greater than area of reinforcement required

Check base design at toe

Depth of section

$$h = 300 \text{ mm}$$

Rectangular section in flexure - Section 6.1

Design bending moment combination 1

$$M = 73.1 \text{ kNm/m}$$

Depth to tension reinforcement

$$d = h - C_{bb} - \phi_{bb} / 2 = 217 \text{ mm}$$

$$K = M / (d^2 \times f_{ck}) = 0.052$$

$$K' = (2 \times \eta \times \alpha_{cc} / \gamma_c) \times (1 - \lambda \times (\delta - K_1) / (2 \times K_2)) \times (\lambda \times (\delta - K_1) / (2 \times K_2))$$

$$K' = 0.207$$

K' > K - No compression reinforcement is required

Lever arm

$$z = \min(0.5 + 0.5 \times (1 - 2 \times K / (\eta \times \alpha_{cc} / \gamma_c))^{0.5}, 0.95) \times d = 206 \text{ mm}$$

Depth of neutral axis

$$x = 2.5 \times (d - z) = 27 \text{ mm}$$

Area of tension reinforcement required

$$A_{bb,req} = M / (f_{yd} \times z) = 815 \text{ mm}^2/m$$

Tension reinforcement provided

$$16 \text{ dia.bars @ } 150 \text{ c/c}$$

Area of tension reinforcement provided

$$A_{bb,prov} = \pi \times \phi_{bb}^2 / (4 \times s_{bb}) = 1340 \text{ mm}^2/m$$

Minimum area of reinforcement - exp.9.1N

$$A_{bb,min} = \max(0.26 \times f_{ctm} / f_{yk}, 0.0013) \times d = 327 \text{ mm}^2/m$$

Maximum area of reinforcement - cl.9.2.1.1(3)

$$A_{bb,max} = 0.04 \times h = 12000 \text{ mm}^2/m$$

$$\max(A_{bb,req}, A_{bb,min}) / A_{bb,prov} = 0.608$$

PASS - Area of reinforcement provided is greater than area of reinforcement required

Library item: Rectangular single output

Crack control - Section 7.3

Limiting crack width

$$w_{max} = 0.3 \text{ mm}$$

Variable load factor - EN1990 – Table A1.1

$$\psi_2 = 0.6$$

Serviceability bending moment

$$M_{sls} = 53.3 \text{ kNm/m}$$

Tensile stress in reinforcement

$$\sigma_s = M_{sls} / (A_{bb,prov} \times z) = 192.9 \text{ N/mm}^2$$

Load duration

$$\text{Long term}$$

Load duration factor

$$k_t = 0.4$$

Effective area of concrete in tension

$$A_{c,eff} = \min(2.5 \times (h - d), (h - x) / 3, h / 2)$$

$$A_{c,eff} = 90958 \text{ mm}^2/m$$

Mean value of concrete tensile strength

$$f_{ct,eff} = f_{ctm} = 2.9 \text{ N/mm}^2$$

Reinforcement ratio

$$\rho_{p,eff} = A_{bb,prov} / A_{c,eff} = 0.015$$

Modular ratio

$$\alpha_e = E_s / E_{cm} = 6.091$$

Bond property coefficient

$$k_1 = 0.8$$

Strain distribution coefficient

$$k_2 = 0.5$$

$$k_3 = 3.4$$

$$k_4 = 0.425$$

Maximum crack spacing - exp.7.11

$$s_{r,max} = k_3 \times C_{bb} + k_1 \times k_2 \times k_4 \times \phi_{bb} / \rho_{p,eff} = 440 \text{ mm}$$

Reinforcement details



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Job Title	GARAGE ON FERRESTONE ROAD, LONDON	Date	Made by	Checked by
Section	UPLIFT CHECK	18.01.23	SB	AB

Loadings

Uplift pressure (characteristic) = 40 KN/m²

Derivation of loadings (characteristic) for uplift check

Floor	Loadings per sq m		Area (sq m)	Total point load per floor	
	DL	LL		DL	LL
Roof	0.9	0.6	22	19.8	13.2
Second floor	0.6	2.0	22	13.2	44.0
First floor	0.6	2.0	22	13.2	44.0
Ground floor	8.5	2.0	39	331.5	78.0
Basement floor	8.5	2.0	39	331.5	78.0

Wall	Loadings per sq m		Height (m)	Length (m)	Total udl	
	DL	LL			DL	LL
Cavity wall	3.8	0.0	6.8	12.0	310.1	0.0
Basement RC wall	7.5	0.0	3.6	32.0	864.0	0.0

	DL	LL
Total udl	1883.3	257.2

Design for uplift at ultimate limit stage (EQU)

Actions:

Permanent (favourable) =>	$\gamma_G = 0.9$
Permanent (unfavourable) =>	$\gamma_G = 1.1$
Variable (favourable) =>	$\gamma_Q = 0.0$
Variable (unfavourable) =>	$\gamma_Q = 1.5$

Assuming the uplift pressure as permanent unfavourable, the building permanent loads as favourable, and the building variable load as favourable:

Stabilizing action $0.9 * 1883.3 / 32 = 53$ KN/m² (assuming 32 sq m the gross area of the basement slab bearing on ground)

Destabilising action = $1.1 * 40 = 44$ KN/m²

Stabilising action > destabilising action => EQU check is satisfied. Heave protection required below 10sq m of the basement slab



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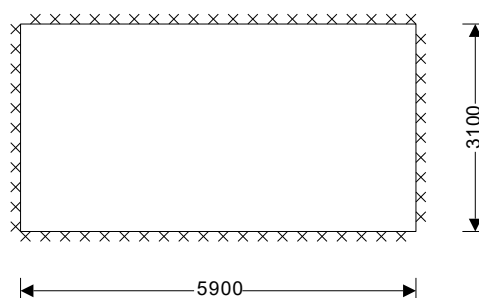
RC SLAB DESIGN

In accordance with EN1992-1-1:2004 incorporating corrigendum January 2008 and the UK national annex

Tedds calculation version 1.0.21

Design summary

Description	Unit	Provided	Required	Utilisation	Result
Short span					
Reinf. at midspan	mm ² /m	1340	387	0.289	PASS
Bar spacing at midspan	mm	150	300	0.500	PASS
Reinf. at support	mm ² /m	1340	364	0.272	PASS
Bar spacing at support	mm	150	300	0.500	PASS
Shear at cont. supp	kN/m	141.3	68.0	0.481	PASS
Deflection ratio		12.06	60.00	0.201	PASS
Long span					
Reinf. at midspan	mm ² /m	1340	363	0.271	PASS
Bar spacing at midspan	mm	150	300	0.500	PASS
Reinf. at support	mm ² /m	1340	340	0.254	PASS
Bar spacing at support	mm	150	300	0.500	PASS
Shear at cont. supp	kN/m	137.3	68.0	0.495	PASS
Cover					
Min cover top	mm	50	26	0.520	PASS
Min cover bottom	mm	35	26	0.743	PASS



Slab definition

Slab reference name

Type of slab

Overall slab depth

Shorter effective span of panel

Longer effective span of panel

Support conditions

Top outer layer of reinforcement

Bottom outer layer of reinforcement

Basement slab

Two way spanning with restrained edges

$h = 300$ mm

$l_x = 3100$ mm

$l_y = 5900$ mm

Four edges continuous (interior panel)

Short span direction

Short span direction

Loading

Characteristic permanent action

Characteristic variable action

Partial factor for permanent action

Partial factor for variable action

Quasi-permanent value of variable action

Design ultimate load

Quasi-permanent load

$G_k = 32.5$ kN/m²

$Q_k = 0.0$ kN/m²

$\gamma_G = 1.35$

$\gamma_Q = 1.50$

$\psi_2 = 0.30$

$q = \gamma_G \times G_k + \gamma_Q \times Q_k = 43.9$ kN/m²

$q_{SLS} = 1.0 \times G_k + \psi_2 \times Q_k = 32.5$ kN/m²

Note: The uplift pressure (40kN/m², considered permanent action) is reduced allowing for the counteracting action of the slab self weight (7.5kN/m²)



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Concrete properties

Concrete strength class	C30/37
Characteristic cylinder strength	$f_{ck} = 30 \text{ N/mm}^2$
Partial factor (Table 2.1N)	$\gamma_C = 1.50$
Compressive strength factor (cl. 3.1.6)	$\alpha_{cc} = 0.85$
Design compressive strength (cl. 3.1.6)	$f_{cd} = 17.0 \text{ N/mm}^2$
Mean axial tensile strength (Table 3.1)	$f_{ctm} = 0.30 \text{ N/mm}^2 \times (f_{ck} / 1 \text{ N/mm}^2)^{2/3} = 2.9 \text{ N/mm}^2$
Maximum aggregate size	$d_g = 20 \text{ mm}$

Reinforcement properties

Characteristic yield strength	$f_{yk} = 500 \text{ N/mm}^2$
Partial factor (Table 2.1N)	$\gamma_S = 1.15$
Design yield strength (fig. 3.8)	$f_{yd} = f_{yk} / \gamma_S = 434.8 \text{ N/mm}^2$

Concrete cover to reinforcement

Nominal cover to outer top reinforcement	$c_{nom_t} = 50 \text{ mm}$
Nominal cover to outer bottom reinforcement	$c_{nom_b} = 35 \text{ mm}$
Fire resistance period to top of slab	$R_{top} = 60 \text{ min}$
Fire resistance period to bottom of slab	$R_{btm} = 60 \text{ min}$
Axis distance to top reinf (Table 5.8)	$a_{fi_t} = 15 \text{ mm}$
Axis distance to bottom reinf (Table 5.8)	$a_{fi_b} = 15 \text{ mm}$
Min. top cover requirement with regard to bond	$c_{min_b_t} = 16 \text{ mm}$
Min. btm cover requirement with regard to bond	$c_{min_b_b} = 16 \text{ mm}$
Reinforcement fabrication	Not subject to QA system
Cover allowance for deviation	$\Delta C_{dev} = 10 \text{ mm}$
Min. required nominal cover to top reinf	$c_{nom_t_min} = 26.0 \text{ mm}$
Min. required nominal cover to bottom reinf	$c_{nom_b_min} = 26.0 \text{ mm}$

PASS - There is sufficient cover to the top reinforcement

PASS - There is sufficient cover to the bottom reinforcement

Reinforcement design at midspan in short span direction (cl.6.1)

Bending moment coefficient	$\beta_{sx_p} = 0.0465$
Design bending moment	$M_{x_p} = \beta_{sx_p} \times q \times l_x^2 = 19.6 \text{ kNm/m}$
Reinforcement provided	16 mm dia. bars at 150 mm centres
Area provided	$A_{sx_p} = 1340 \text{ mm}^2/\text{m}$
Effective depth to tension reinforcement	$d_{x_p} = h - c_{nom_b} - \phi_{x_p} / 2 = 257.0 \text{ mm}$
K factor	$K = M_{x_p} / (b \times d_{x_p}^2 \times f_{ck}) = 0.010$
Redistribution ratio	$\delta = 1.0$
K' factor	$K' = 0.598 \times \delta - 0.18 \times \delta^2 - 0.21 = 0.208$

K < K' - Compression reinforcement is not required

Lever arm	$z = \min(0.95 \times d_{x_p}, d_{x_p} / 2 \times (1 + \sqrt{(1 - 3.53 \times K)})) = 244.2 \text{ mm}$
Area of reinforcement required for bending	$A_{sx_p_m} = M_{x_p} / (f_{yd} \times z) = 185 \text{ mm}^2/\text{m}$
Minimum area of reinforcement required	$A_{sx_p_min} = \max(0.26 \times (f_{ctm} / f_{yk}) \times b \times d_{x_p}, 0.0013 \times b \times d_{x_p}) = 387 \text{ mm}^2/\text{m}$
Area of reinforcement required	$A_{sx_p_req} = \max(A_{sx_p_m}, A_{sx_p_min}) = 387 \text{ mm}^2/\text{m}$

PASS - Area of reinforcement provided exceeds area required

Check reinforcement spacing

Reinforcement service stress	$\sigma_{sx_p} = (f_{yk} / \gamma_S) \times \min((A_{sx_p_m} / A_{sx_p}), 1.0) \times q_{SLS} / q = 44.3 \text{ N/mm}^2$
Maximum allowable spacing (Table 7.3N)	$s_{max_x_p} = 300 \text{ mm}$



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Actual bar spacing

$s_{x_p} = 150$ mm

PASS - The reinforcement spacing is acceptable

Reinforcement design at midspan in long span direction (cl.6.1)

Bending moment coefficient

$\beta_{sy_p} = 0.0240$

Design bending moment

$M_{y_p} = \beta_{sy_p} \times q \times l_x^2 = 10.1$ kNm/m

Reinforcement provided

16 mm dia. bars at 150 mm centres

Area provided

$A_{sy_p} = 1340$ mm²/m

Effective depth to tension reinforcement

$d_{y_p} = h - c_{nom_b} - \phi_{x_p} - \phi_{y_p} / 2 = 241.0$ mm

K factor

$K = M_{y_p} / (b \times d_{y_p}^2 \times f_{ck}) = 0.006$

Redistribution ratio

$\delta = 1.0$

K' factor

$K' = 0.598 \times \delta - 0.18 \times \delta^2 - 0.21 = 0.208$

K < K' - Compression reinforcement is not required

Lever arm

$z = \min(0.95 \times d_{y_p}, d_{y_p} / 2 \times (1 + \sqrt{1 - 3.53 \times K})) = 229.0$ mm

Area of reinforcement required for bending

$A_{sy_p_m} = M_{y_p} / (f_{yd} \times z) = 102$ mm²/m

Minimum area of reinforcement required

$A_{sy_p_min} = \max(0.26 \times (f_{ctm}/f_{yk}) \times b \times d_{y_p}, 0.0013 \times b \times d_{y_p}) = 363$ mm²/m

Area of reinforcement required

$A_{sy_p_req} = \max(A_{sy_p_m}, A_{sy_p_min}) = 363$ mm²/m

PASS - Area of reinforcement provided exceeds area required

Check reinforcement spacing

Reinforcement service stress

$\sigma_{sy_p} = (f_{yk} / \gamma_s) \times \min((A_{sy_p_m}/A_{sy_p}), 1.0) \times q_{SLS} / q = 24.4$ N/mm²

Maximum allowable spacing (Table 7.3N)

$s_{max_y_p} = 300$ mm

Actual bar spacing

$s_{y_p} = 150$ mm

PASS - The reinforcement spacing is acceptable

Reinforcement design at continuous support in short span direction (cl.6.1)

Bending moment coefficient

$\beta_{sx_n} = 0.0615$

Design bending moment

$M_{x_n} = \beta_{sx_n} \times q \times l_x^2 = 25.9$ kNm/m

Reinforcement provided

16 mm dia. bars at 150 mm centres

Area provided

$A_{sx_n} = 1340$ mm²/m

Effective depth to tension reinforcement

$d_{x_n} = h - c_{nom_t} - \phi_{x_n} / 2 = 242.0$ mm

K factor

$K = M_{x_n} / (b \times d_{x_n}^2 \times f_{ck}) = 0.015$

Redistribution ratio

$\delta = 1.0$

K' factor

$K' = 0.598 \times \delta - 0.18 \times \delta^2 - 0.21 = 0.208$

K < K' - Compression reinforcement is not required

Lever arm

$z = \min(0.95 \times d_{x_n}, d_{x_n} / 2 \times (1 + \sqrt{1 - 3.53 \times K})) = 229.9$ mm

Area of reinforcement required for bending

$A_{sx_n_m} = M_{x_n} / (f_{yd} \times z) = 259$ mm²/m

Minimum area of reinforcement required

$A_{sx_n_min} = \max(0.26 \times (f_{ctm}/f_{yk}) \times b \times d_{x_n}, 0.0013 \times b \times d_{x_n}) = 364$ mm²/m

Area of reinforcement required

$A_{sx_n_req} = \max(A_{sx_n_m}, A_{sx_n_min}) = 364$ mm²/m

PASS - Area of reinforcement provided exceeds area required

Check reinforcement spacing

Reinforcement service stress

$\sigma_{sx_n} = (f_{yk} / \gamma_s) \times \min((A_{sx_n_m}/A_{sx_n}), 1.0) \times q_{SLS} / q = 62.3$ N/mm²

Maximum allowable spacing (Table 7.3N)

$s_{max_x_n} = 300$ mm

Actual bar spacing

$s_{x_n} = 150$ mm

PASS - The reinforcement spacing is acceptable

Reinforcement design at continuous support in long span direction (cl.6.1)

Bending moment coefficient

$\beta_{sy_n} = 0.0320$

Design bending moment

$M_{y_n} = \beta_{sy_n} \times q \times l_x^2 = 13.5$ kNm/m



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Reinforcement provided 16 mm dia. bars at 150 mm centres
Area provided $A_{sy_n} = 1340 \text{ mm}^2/\text{m}$
Effective depth to tension reinforcement $d_{y_n} = h - c_{nom_t} - \phi_{x_n} - \phi_{y_n} / 2 = 226.0 \text{ mm}$
K factor $K = M_{y_n} / (b \times d_{y_n}^2 \times f_{ck}) = 0.009$
Redistribution ratio $\delta = 1.0$
K' factor $K' = 0.598 \times \delta - 0.18 \times \delta^2 - 0.21 = 0.208$

K < K' - Compression reinforcement is not required

Lever arm $z = \min(0.95 \times d_{y_n}, d_{y_n} / 2 \times (1 + \sqrt{1 - 3.53 \times K})) = 214.7 \text{ mm}$
Area of reinforcement required for bending $A_{sy_n_m} = M_{y_n} / (f_{yd} \times z) = 145 \text{ mm}^2/\text{m}$
Minimum area of reinforcement required $A_{sy_n_{min}} = \max(0.26 \times (f_{ctm}/f_{yk}) \times b \times d_{y_n}, 0.0013 \times b \times d_{y_n}) = 340 \text{ mm}^2/\text{m}$
Area of reinforcement required $A_{sy_n_{req}} = \max(A_{sy_n_m}, A_{sy_n_{min}}) = 340 \text{ mm}^2/\text{m}$
PASS - Area of reinforcement provided exceeds area required

Check reinforcement spacing

Reinforcement service stress $\sigma_{sy_n} = (f_{yk} / \gamma_s) \times \min((A_{sy_n_m}/A_{sy_n}), 1.0) \times q_{SLS} / q = 34.7 \text{ N/mm}^2$
Maximum allowable spacing (Table 7.3N) $s_{max_{y_n}} = 300 \text{ mm}$
Actual bar spacing $s_{y_n} = 150 \text{ mm}$

PASS - The reinforcement spacing is acceptable

Shear capacity check at short span continuous support

Shear force $V_{x_n} = q \times l_x / 2 = 68.0 \text{ kN/m}$
Effective depth factor (cl. 6.2.2) $k = \min(2.0, 1 + (200 \text{ mm} / d_{x_n})^{0.5}) = 1.909$
Reinforcement ratio $\rho_l = \min(0.02, A_{sx_n} / (b \times d_{x_n})) = 0.0055$
Minimum shear resistance (Exp. 6.3N) $V_{Rd,c_{min}} = 0.035 \text{ N/mm}^2 \times k^{1.5} \times (f_{ck} / 1 \text{ N/mm}^2)^{0.5} \times b \times d_{x_n}$
 $V_{Rd,c_{min}} = 122.4 \text{ kN/m}$
Shear resistance constant (cl. 6.2.2) $C_{Rd,c} = 0.18 \text{ N/mm}^2 / \gamma_c = 0.12 \text{ N/mm}^2$
Shear resistance (Exp. 6.2a)

$$V_{Rd,c_{x_n}} = \max(V_{Rd,c_{min}}, C_{Rd,c} \times k \times (100 \times \rho_l \times (f_{ck} / 1 \text{ N/mm}^2))^{0.333} \times b \times d_{x_n}) = 141.3 \text{ kN/m}$$

PASS - Shear capacity is adequate

Shear capacity check at long span continuous support

Shear force $V_{y_n} = q \times l_x / 2 = 68.0 \text{ kN/m}$
Effective depth factor (cl. 6.2.2) $k = \min(2.0, 1 + (200 \text{ mm} / d_{y_n})^{0.5}) = 1.941$
Reinforcement ratio $\rho_l = \min(0.02, A_{sy_n} / (b \times d_{y_n})) = 0.0059$
Minimum shear resistance (Exp. 6.3N) $V_{Rd,c_{min}} = 0.035 \text{ N/mm}^2 \times k^{1.5} \times (f_{ck} / 1 \text{ N/mm}^2)^{0.5} \times b \times d_{y_n}$
 $V_{Rd,c_{min}} = 117.1 \text{ kN/m}$
Shear resistance constant (cl. 6.2.2) $C_{Rd,c} = 0.18 \text{ N/mm}^2 / \gamma_c = 0.12 \text{ N/mm}^2$
Shear resistance (Exp. 6.2a)

$$V_{Rd,c_{y_n}} = \max(V_{Rd,c_{min}}, C_{Rd,c} \times k \times (100 \times \rho_l \times (f_{ck} / 1 \text{ N/mm}^2))^{0.333} \times b \times d_{y_n}) = 137.3 \text{ kN/m}$$

PASS - Shear capacity is adequate

Basic span-to-depth deflection ratio check (cl. 7.4.2)

Reference reinforcement ratio $\rho_0 = (f_{ck} / 1 \text{ N/mm}^2)^{0.5} / 1000 = 0.0055$
Required tension reinforcement ratio $\rho = \max(0.0035, A_{sx_{p_{req}}} / (b \times d_{x_p})) = 0.0035$
Required compression reinforcement ratio $\rho' = A_{scx_{p_{req}}} / (b \times d_{x_p}) = 0.0000$
Structural system factor (Table 7.4N) $K_\delta = 1.5$
Basic limit span-to-depth ratio (Exp. 7.16)

$$\text{ratio}_{lim_{x_{bas}}} = K_\delta \times [11 + 1.5 \times (f_{ck} / 1 \text{ N/mm}^2)^{0.5} \times \rho_0 / \rho + 3.2 \times (f_{ck} / 1 \text{ N/mm}^2)^{0.5} \times (\rho_0 / \rho - 1)^{1.5}] = 46.95$$

Mod span-to-depth ratio limit



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$$\text{ratio}_{\text{lim}_x} = \min(40 \times K_{\delta}, \min(1.5, (500 \text{ N/mm}^2 / f_{yk}) \times (A_{sx_p} / A_{sx_{p_m}})) \times \text{ratio}_{\text{lim}_x_{\text{bas}}}) = \mathbf{60.00}$$

Actual span-to-eff. depth ratio

$$\text{ratio}_{\text{act}_x} = l_x / d_{x_p} = \mathbf{12.06}$$

PASS - Actual span-to-effective depth ratio is acceptable

Reinforcement summary

Midspan in short span direction

16 mm dia. bars at 150 mm centres B1

Midspan in long span direction

16 mm dia. bars at 150 mm centres B2

Continuous support in short span direction

16 mm dia. bars at 150 mm centres T1

Continuous support in long span direction

16 mm dia. bars at 150 mm centres T2

Reinforcement sketch

The following sketch is indicative only. Note that additional reinforcement may be required in accordance with clauses 9.2.1.2, 9.2.1.4 and 9.2.1.5 of EN 1992-1-1:2004 to meet detailing rules.



APPENDIX C

GEOTECHNICAL REPORT



LMB GEOSOLUTIONS LTD

GROUND INVESTIGATION & ASSESSMENT

1 FERRESTONE ROAD, HORNSEY, LONDON N8 7BX

September 2022

DOCUMENT RECORD

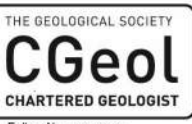
Document Title	Ground Investigation & Assessment
Site	1 Ferrestone Road, Hornsey, London N8 7BX
Document Date	3 rd September 2022
Document Version	Issue 1
Document Authorisation	Philip Lewis BSc (Hons), MSc, CGeol, FGS    Fellow No.: 1012476



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EXECUTIVE SUMMARY

Executive Summary

Site Details	1 Ferrestone Road, Hornsey, London N8 7BX.
Proposed Development	The development proposals comprise construction of a three storey residential property with basement level over part of the proposed building footprint (plant room and storage).
Ground & Groundwater Conditions	Made Ground overlying possible Head Deposits which in turn overlie the London Clay Formation. Groundwater was not recorded during drilling works or during return monitoring.
Desk Study	Overall environmental sensitivity of low to moderate. Overall risk rating of Very Low to Moderate/Low.
Assessment of Soil Analytical Results	Residual soil concentrations (post development) are not considered to pose a risk to future site users. Made Ground soils are likely to be listed as non-hazardous waste and meet non-hazardous waste acceptance criteria. This should be confirmed by the receiving facility and may require additional validation sampling and testing of soils.
Ground Gas	A preliminary assessment suggests risk from bulk ground gases and volatile vapours are very low.
Geotechnical Advice	For traditional strip foundations placed on the competent London Clay Formation at a depth of c. 3.0m below existing ground level, a net safe bearing pressure of 115kN/m² should be available. The above advice assumes that the proposed lower basement development and in particular foundations would not be within the influence of any trees or tree routes. Given the size of the excavation and the adjacent and nearby structures, it is considered likely that temporary or permanent support will be needed for construction. A preliminary appraisal of pile capacities (10m) suggests that safe working loads of c. 117kN and 190kN would be available for 300mm and 450mm pile diameters respectively. Coefficient of active earth pressure: Made Ground: 0.35. possible Head Deposits: 0.37. London Clay: 0.42. Coefficient of passive earth resistance: Made Ground: 3.5. possible Head Deposits: 3.0. London Clay: 2.7. Buried concrete: Made Ground: DS-1, AC-1. London Clay DS-2, AC-2.
Recommendations	The full set of recommendations should be reviewed, but in summary the following are provided: • It is recommended that maintenance and construction workers involved in below ground works adopt appropriate management procedures to mitigate potential risks. • Soils imported for use on site (e.g. garden or landscape areas) should be sampled and analysed to ensure suitability for use.
<i>This executive summary is not a stand alone document and should be read in conjunction with the full report text, including conclusions and recommendations.</i>	

INTRODUCTION

Introduction

AUTHORISATION

LMB Geosolutions Ltd (LMB) was instructed by Symmetrys Ltd (Consultant Engineers) on behalf of Mr Jonas Grau (the Client) in May 2021 to undertake ground investigation and assessment works in relation to the proposed development at 1 Ferrestone Road, Hornsey, London N8 7BX (the Site).

PROJECT AND SITE DETAILS

Site Address	1 Ferrestone Road, Hornsey, London N8 7BX (the Site). A Site Location Plan is provided as Figure 1 .
Proposed Development	The site currently comprises a single storey garage. It is understood that the client wishes to construct a three storey residential property with basement level over part of the proposed building footprint (plant room and storage). A development schematic is included in Appendix A.
Background	The scope of works and requirements of this report were based on the information provided by Symmetrys (Consultant Engineers) in an email specification and within the following document: • Exploratory hole location plan (ref. Symmetrys 22135-SI-01-Rev P1); and • Appleton Weiner. Pre-Application Drawings.

AIMS & OBJECTIVES

This report aims to provide information sufficient to meet the requirements outlined in the email specification and associated drawing provided by the Consultant Engineers.

SCOPE OF WORKS

The following scope of works has been completed:

Desk Study (Preliminary Risk Assessment)

- Completion of a site reconnaissance survey to make a preliminary assessment of the Site and surrounding area;
- Review of information on the Local Authority website for records pertaining to the Site;

INTRODUCTION

- Consultation with LUL, Network Rail and Crossrail to ascertain if they have any nearby below ground assets;
- Acquisition of a site specific Groundsure enviro insight report to identify potential land contamination issues on and surrounding the Site;
- Review of 'bomb site' website to provide an initial appraisal of potential UXO threat (factual information only);
- Assessment of the 'sensitivity' of the Site location as determined by factors such as hydrogeology, proximity of watercourses, neighbouring land use, ecologically sensitive uses and geology detailed on British Geological Survey (BGS) maps;
- Completion of an interpretive report (to be included within the main ground investigation report) that will include;
 - Details of current site conditions based on the reconnaissance survey;
 - Production of a preliminary conceptual site model;
 - Provision of a Preliminary Risk Assessment outlining potential land contamination issues associated with the proposed development.

Ground Investigation & Assessment

- Site set up including liaison with Consultant Engineers, Client and appointment of sub-contractors;
- Mobilisation to site and transport of the rig to the proposed location;
- Completion of 1No. dynamic (windowless) sampler borehole to a depth of 10.00m bgl with insitu testing and collection of disturbed and undisturbed samples for laboratory testing;
- Completion of 4no. hand excavated trial pits to a maximum depth of 1.20m bgl to expose and inspect existing building foundations;
- Supervision and geological logging of the soil arisings in accordance with BS5930 by an appropriately experienced geo-environmental engineer;
- Installation of 1no. monitoring well to a depth of 5.0m below ground level and return monitoring of ground gas and groundwater levels on 1no. occasion;
- Geotechnical laboratory testing of the soil samples for an appropriate suite of determinands (including pH, sulphate, triaxial testing, Atterberg limits, and moisture content);
- Chemical analysis of 1no. sample of Made Ground soils, including Waste Acceptance Criteria (WAC);
- Completion of a factual and interpretive report that includes;
 - Details of the ground and groundwater conditions encountered;
 - Schematic sections of exposed foundations;
 - Presentation of chemical analytical results;
 - Geotechnical laboratory testing and provision of advice on the material properties of the shallow soil horizon including parameters to aid in retaining wall design and foundation options; &

INTRODUCTION

- Conclusions and recommendations.

CONTRIBUTORS

The desk study section of this report has been prepared by Christopher Hall, an environmental consultant with an MSc in Applied Environmental Hydrogeology and over ten years of experience. Christopher specialises in contaminated land and hydrogeology having worked on a wide range of investigations and assessments across a multitude of sectors.

This report has been reviewed and authorised by Philip Lewis, a hydrogeologist and chartered Geologist with over twenty years experience as a geoscience professional, including over twenty years experience as a professional adviser (consultant) in hydrogeology, engineering geology and contaminated land.

LIMITATIONS

LMB has prepared this report solely for the use of the named Client and those parties with whom a warranty agreement and/or assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from LMB and the Client.

LMB accepts no responsibility or liability for:

- a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and
- b) issue of this document to any third party with whom an agreement has not been executed.

The risk assessment and opinions provided, among other things, take in to consideration currently available guidance and best available techniques relating to acceptable contamination concentrations and interpretation of these values. No liability can be accepted for the retrospective effects of any future changes or amendments to these value.

DESK STUDY

Desk Study

A Desk Study has been undertaken and is presented in this section in order to provide further background and context for the ground investigation and assessment presented in the later sections of this report.

DATA SOURCES

The following data sources have been used to inform the desk study:

- British Geological Survey – 1:50,000 Geological Sheet 256, North London (Solid & Drift);
- British Geological Survey borehole archive records;
- Environment Agency Groundwater Vulnerability Mapping (1:100,000 series) Sheet 40, Thames;
- Information contained on the gov.uk website (<https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>);
- Defra Magic website (<https://magic.defra.gov.uk/>);
- Environment Agency Catchment Data Explorer (<https://environment.data.gov.uk/catchment-planning/>);
- NERC (2008). UK Hydrometric Register;
- River Basin Management Plan (RBMP). Thames River Basin District (2009); and
- Groundsure Enviro Insight Report (ref. GS-8952955).

SITE RECONNAISSANCE

A representative of LMB completed a site walkover survey in July 2022 that was limited to external areas. A photographic record is provided as **Appendix B**.

The site currently comprises a single storey vehicle garage which is set back off Ferrestone Road (see Plate 1). The garage lies adjacent to three storey (including roof) residential terrace property of 1 Ferrestone Road the west. In, addition is lies adjacent to rear garden walls of 16 and 17 Church Lane to the east (see Plates 1 & 2). The properties on the opposite side of Ferrestone Road (7 & 8) include lower ground floors.

There was no obvious evidence of structural damage (e.g. cracked bricks) to the external (front) area of the garage.

The site is located on a residential road that slopes gently to the west with a prevailing slope to the north over the wider area.

Occasional of shrubs and trees of varying maturity were observed mainly located within the front garden areas of the residential properties.

DESK STUDY

ENVIRONMENTAL SETTING

Published Geology & Aquifer Designations	Reference to British Geological Survey (BGS) Digital Map (1:50,000), the groundsure report and accessible information contained on the Defra Magic website (https://magic.defra.gov.uk/) indicates that the Site is located directly over the London Clay Formation which is designated Unproductive Strata.
Local Hydrology	Reference to information in the Groundsure report (ref. GS-8952955) and available mapping indicates that the nearest surface water feature is the New River, which is located approximately 280m northeast of the Site at its closest point. The New River generally flows in a south easterly direction. In addition, the Moselle Brook is located approximately 370m NW of the site. Reference to the <i>Lost Rivers of London</i> (Barton, N.J, 1982) indicates that Moselle Brook is one of the lost rivers that has been adopted into the local drainage system. Information relating to the Thames region within the UK Hydrometric Register indicates that the average annual rainfall in the region is 710mm. Information contained on the gov.uk website indicates that the Site is in an area at very low risk of flooding from rivers and sea and low risk from surface water flooding. Further information within the Groundsure report (ref. GS-8952955) suggests that the surface water flood depth for a 1 in 1000 year storm event is negligible. In addition, the Groundsure report suggests there is a negligible risk from groundwater flooding. Please note that the above factual information does not constitute a flood risk assessment.
Resource Potential & Ecological Quality	Surface Water: The nearest surface water feature is the New River, located approximately 280m northeast of the Site. This feature is not included within the relevant River Basin Management Plan (RBMP). However, the site is within the catchment of the Moselle Brook (approx. 370m NW) which is included within the relevant RBMP (Lee Lower Rivers and Lakes) and has been assigned moderate ecological quality but fails chemical quality. There are no licensed surface water abstractions within 1km of the Site. Groundwater: The groundwater in the London Clay Formation is designated Unproductive Strata and as such is not characterised as a groundwater body within the relevant RBMP. The Site is located within an Inner Catchment (Type 1) of an EA designated Source Protection Zone (SPZ). The nearest active licensed groundwater abstraction is located approximately 270m northeast of the Site. The licence is operated by Thames Water Utilities Ltd and for

DESK STUDY

	potable water uses. It is assumed that the groundwater is abstracted at depth from the Principal Chalk Aquifer.
Surrounding Land Use	Surrounding land uses are primarily residential with associated shops and amenities.
Local Designations	Reference to information contained in the Groundsure report indicates that there are no environmental designations (e.g. Sites of Special Scientific Interest) within 500m of the Site.

BELOW GROUND ASSETS

As part of the assessment the following organisations were contacted to ascertain if they held any below ground assets below or in close proximity to the site:

- Network Rail;
- Crossrail;
- London Underground Ltd / Transport for London.

Responses have been received from all organisations confirming they do not hold any below ground assets in the vicinity of the site.

Copies of correspondence are included in **Appendix C**.

SUMMARY OF LIKELY GROUND & GROUNDWATER CONDITIONS

The information presented in the following sections is based on review of available BGS borehole logs for the local area and interpretation of BGS mapping. The interpretation of this information should be considered preliminary pending completion of site specific ground investigation works.

Local Ground and Groundwater Conditions

Three BGS borehole logs are located within 250m of the Site and are detailed below.

A borehole (TQ38NW4) is located approximately 90m north of the Site and recorded the London Clay Formation to 43.3m bgl. The London Clay Formation was underlain by clays and sands (considered to be the Reading Beds) to 54m bgl. The Reading Beds were underlain by sands (considered to be the Thanet Sand Formation) to 61m bgl. The Thanet Sand Formation was underlain by Chalk to an unproven depth of 76.2m bgl. Groundwater strikes were not recorded on the log.

A borehole (TQ38NW275) is located approximately 200m west of the Site and recorded Made Ground to 0.5m bgl. The Made Ground was underlain by a stiff clay (considered to be the London Clay Formation) to a proven depth of 3m bgl. Groundwater was not encountered during drilling.

DESK STUDY

A borehole (TQ38NW303) is located approximately 250m south of the Site and recorded Made Ground to 3.1m bgl. The Made Ground was underlain by a silty clay (considered to be the London Clay Formation) to a proven depth of 10m bgl. Groundwater was not encountered during drilling.

Copies of the BGS borehole logs are provided in **Appendix D**.

POTENTIALLY CONTAMINATIVE HISTORICAL LAND USE

A review of historical data within the Groundsure Enviro Insight Report (GS-8952955) has been completed to identify potentially contaminative previous land uses on site and within 250m of the Site.

Date	On Site Features	Off Site Features
1869	-	Grave Yard 47m north. Nursery 190m northwest. Railway sidings 240m east.
1879	-	Grave Yard 47m north. Nursery 190m northwest. Railway sidings 240m east.
1894	-	Railway sidings 197m east. Unspecified works 207m north. Railway building 214m east. Railway building 222m east. Railway station 241m east.
1911	-	Unspecified works 213m northwest. Railway sidings 223m east. Railway sidings 230m east. Railway station 238m east.
1914	-	Unspecified tank 202m southeast. Electric Light Station 106m southeast.

DESK STUDY

Date	On Site Features	Off Site Features
1920	-	Railway sidings 157m southeast. Railway sidings 168m southeast. Railway building 222m east. Railway station 228m east.
1938	-	Railway sidings 162m east. Unspecified commercial/industrial 209m north. Railway station 228m east.
1954	-	Electricity workshops 101m southeast. Electricity workshops 102m southeast. Electricity substation 111m southeast. Electricity substation 112m southeast. Electricity substation 185m southeast. Electricity substation 188m southeast. Electricity substation 206m southeast. Garage 210m north. Garage 238m north. Garage 239m north. Garage 240m southwest.
1962	-	Railway sidings 157m southeast. Railway building 197m east. Railway building 214m east. Railway building 216m east. Railway building 243m east.
1963	-	Unspecified tank 163m southeast.

DESK STUDY

Date	On Site Features	Off Site Features
1965	-	Garage 241m southwest.
1967	-	Railway sidings 157m southeast. Railway building 201m east. Cold Store 211m southeast. Railway building 216m east. Railway station 223m east.
1971	-	Unspecified tank 163m southeast. Electricity substation 14m north. Electricity substation 130m southeast. Garage 210m north. Garage 221m east.
1975	-	Railway sidings 157m southeast. Railway sidings 179m southeast. Water Works 203m north. Cold Store 211m southeast. Railway sidings 223m east. Electricity substation 213m southeast. Electricity substation 234m southwest. Garage 241m southwest.
1978	-	Electricity substation 14m north. Electricity substation 130m southeast. Electricity substation 171m southeast. Electricity substation 242m north. Electricity substation 244m northwest.

DESK STUDY

Date	On Site Features	Off Site Features
		Garage 221m east.
1979	-	Unspecified tank 163m southeast. Electricity substation 14m north. Electricity substation 129m southeast. Electricity substation 173m southeast. Garage 220m east.
1982	-	Police Station 127m south. Railway sidings 157m southeast. Water Works 203m north. Cold Store 205m east. Railway station 226m east.
1989	-	Police Station 127m south. Railway sidings 157m southeast. Water Works 203m north. Cold Store 205m east. Railway station 223m east.
1991	-	Unspecified tank 163m southeast. Electricity substation 14m north. Electricity substation 129m southeast. Electricity substation 173m southeast. Electricity substation 213m southeast. Electricity substation 242m north. Electricity substation 243m northwest. Garage 220m east.

DESK STUDY

Date	On Site Features	Off Site Features
1995	-	Electricity substation 213m southeast. Electricity substation 232m southwest.
1996	-	Unspecified tank 163m southeast. Electricity substation 14m north. Electricity substation 134m southeast. Electricity substation 171m southeast. Electricity substation 240m north. Electricity substation 243m northwest. Garage 221m east.

REVIEW OF PLANNING HISTORY

A search of planning applications on the Haringey Council website has been completed to review existing and proposed development in the vicinity of the Site. No recent planning applications for the Site were identified.

A planning application which included a basement excavation was identified in the vicinity of the Site and is detailed below:

- Lower Maisonette, 9 Ferrestone Road, London N8 7BX (ref: HGY/2011/1975). The application was submitted on 25 October 2011 for the 'Erection of a single storey side / rear extension and excavation of basement and lower the floor to create a uniformed height.' The application was permitted on 21 January 2012.

Other identified planning applications in the vicinity of the Site were generally for building extensions and building conversions to flats.

UNEXPLODED ORDNANCE (UXO) REVIEW

A review of the 'bombsight' website (<http://bombsight.org>) identifies a record of a high explosive bomb landing approximately 200m southwest of the Site at Lightfoot Road, Hornsey, London N8 7PN. The bomb is recorded to have fallen between October 7, 1940 and June 6, 1941.

A review of the Zetica risk maps (<https://zeticauxo.com/downloads-and-resources/risk-maps/>) for the area suggests that the Site is located in an area with a moderate risk of UXO.

DESK STUDY

ENVIRONMENTAL & PERMITTING DATA

The table below provides a summary of the environmental and permitting data for the site and surrounding area:

Item	On Site	0 – 250m	Description
Part A (2) and Part B Activities	0	0	-
Discharge Consents	0	0	-
Pollution Incidents	0	4	The nearest pollution incident is located 234m east of the Site. The incident date is March 2003 and the pollutant is diesel. The incident was designated as Category 3 (minor) for water impact and Category 4 (no impact) for land and air impact.
Recent Industrial Land Uses	0	20	Recent industrial land uses include an electricity substation 17m north, a container and storage facility 184m southeast, construction supplier 223m north and a vehicle repair, testing and servicing facility 232m east.
Registered Radioactive Substances	0	0	-
IPC & IPPC Authorisations	0	0	-
Historical & Registered Landfills	0	0	-
Current or recent petrol stations	0	1	A current/recent petrol station entry is located 202m east of the Site. The status of the petrol station is 'obsolete'.
Waste Sites (including waste exemptions)	0	2	Waste Exemption sites are located 223m and 250m north of the Site. The exemptions are for 'use of waste in construction'.
Historical Waste Sites	0	0	-

DESK STUDY

RADON

Information on the UK Health Security Agency online interactive map indicates that the Site is located in an area where less than 1% of properties are above the Action Level.

However, information within guidance documents (BRE report BR211 amongst others) suggests that developments including basements will be at an increased risk from Radon regardless of geographical location.

ENVIRONMENTAL SENSITIVITY

Overall, the site setting is considered to be of **low to moderate** environmental sensitivity, for the following reasons:

- The Site is located in a predominantly residential and commercial land use area;
- The Site is underlain by the London Clay Formation, which is designated Unproductive Strata;
- The Site is located within an Inner Catchment (Type 1) SPZ;
- The Site is located within an area with very low risk of flooding from rivers and sea, a low risk from surface water flooding and a negligible risk of groundwater flooding;
- The nearest surface water feature is the New River, located approximately 280m northeast of the Site; and
- There are no recorded environmental designated sensitive land uses within 500m of the Site.

PRELIMINARY CONCEPTUAL SITE MODEL

The information presented in the previous sections of this report and within the former Environment Agency/DEFRA document; Priority Contaminants for the Assessment of Land (CLR8)¹ have been used to complete a Preliminary Conceptual Site Model (PCSM) that details the potential contaminant sources, pathways and receptors.

The PCSM is presented in the table below:

Potential Contaminant Sources	On-site	• Possible Made Ground
	Off-site	• Former and current electricity substations from 14m of the Site. • Former graveyard within 50m of site. • Former and current railway sidings and buildings within 160m of the Site. • Current tank located approximately 160m from the Site.

¹ This document has been withdrawn but is considered to remain useful in providing technical background for identifying potential sources of contamination and designing ground investigation works.

DESK STUDY

		- Current garage located approximately 220m from the Site. - Current petrol station located approximately 200m from the Site.
Associated Contaminant	On-site	Potential contaminants associated with likely Made Ground including heavy metals, asbestos, organic contaminants, bulk ground gases & volatile vapours.
	Off-site	- Heavy metals and inorganic contaminants. - Organic contaminants (including petroleum hydrocarbons). - Bulk ground gases & volatile vapours.
Receptors		- Future Site users. - Neighbouring residents. - Maintenance and construction workers (acute risk only). - New built development.
Pathways to Receptors		- Direct contact, inhalation and ingestion of contaminants within any shallow soils (acute risk during groundworks and maintenance). - Perched groundwater migration. - Migration of ground gas & volatile vapours.

POLLUTANT LINKAGE ASSESSMENT

The likelihood of pollutant linkages being present between the potential contaminant sources, pathways and receptors identified in the PCSM are outlined in the table below:

Pathway Linkage	Likelihood of Pollutant Linkage	Consequences	Risk Rating	Reasoning
Future Site Users (Direct exposure pathway)				
Ingestion/Dermal Contact/Inhalation (Site Users).	Low	Medium	Moderate/Low	Potential on-site sources of contamination are limited to the possible presence of Made Ground soils. A large proportion of these soils (and associated potential contamination) will be removed as part of the proposed development (i.e.
Ingestion/Dermal Contact/Inhalation (Maintenance and	Low	Medium	Moderate/Low	

DESK STUDY

Pathway Linkage	Likelihood of Pollutant Linkage	Consequences	Risk Rating	Reasoning
Construction Workers).				basement excavation). Some residual soils will remain, but hard surfacing is present and will be retained post development. Potential exposure for maintenance and construction workers will be acute and it is assumed they will adopt appropriate management procedures to mitigate potential risks.
Future Site Users (Indirect exposure pathway)				
Enclosed space accumulation of ground gas.	Low	Severe	Moderate/Low	Potential on and off-site sources of ground gas/vapour have been identified. However, a large proportion of the Made Ground soils will be removed as part of the proposed development (i.e. basement excavation) and the presence of low permeability London Clay will reduce potential migration. The potential for off-site sources of ground gas/vapour to migrate onto the Site is limited to areas where residual Made Ground will remain. The underlying London Clay Formation is not considered a potential ground gas source.
Outdoor volatile vapour exposure	Unlikely	Medium	Low	

DESK STUDY

Pathway Linkage	Likelihood of Pollutant Linkage	Consequences	Risk Rating	Reasoning
Ingress into potable water supply pipes	Low	Mild	Low	The basement construction is likely to remove a large portion of potentially impacted Made Ground / soil and it is considered unlikely that upgraded water pipe material will be required. However, confirmation with the statutory undertaker is recommended.
Risks to Buildings via accumulation of ground gas in enclosed spaces and sub-floor voids.	Low	Severe	Moderate/Low	Potential on and off-site sources of ground gas/vapour have been identified. However, a large proportion of the Made Ground soils will be removed as part of the proposed development (i.e. basement excavation) and the presence of low permeability London Clay will reduce potential migration. The potential for off-site sources of ground gas/vapour to migrate onto the site is limited to areas where residual Made Ground will remain. The underlying London Clay Formation is not considered a potential ground gas source.
Water Environment				

DESK STUDY

Pathway Linkage	Likelihood of Pollutant Linkage	Consequences	Risk Rating	Reasoning
Contaminant migration on to neighbouring land.	Unlikely	Medium	Low	Potential on and off-site contaminant sources have been identified, however the Site currently comprises hard surfacing which will be retained post development. Following development the Site will be underlain primarily by the London Clay Formation which is considered unlikely to support a groundwater unit capable of significant contaminant migration. Perched water may be present within any Made Ground, but this is unlikely to have any lateral extent.
Contaminant migration from neighbouring land.	Unlikely	Medium	Low	
Contamination of groundwater	Unlikely	Medium	Low	
Contamination of surface water	Unlikely	Medium	Low	No surface water features have been identified within 250m of the Site.
Foundation Piling				
Creation of a pathway between any near surface contaminants and the underlying aquifers.	Unlikely	Mild	Very Low	If a piled foundation solution is adopted there is a substantial thickness of low permeability London Clay between potential contaminants and sensitive aquifers (e.g. Principal Chalk Aquifer).

DESK STUDY

Pathway Linkage	Likelihood of Pollutant Linkage	Consequences	Risk Rating	Reasoning
Overall Risk Rating			Very Low to Moderate/Low	

GROUND INVESTIGATION & FINDINGS

Ground Investigation & Findings

INTRODUCTION

The ground investigation works were undertaken on 27th July 2022 and comprised the progression of 1no. dynamic (windowless) sampler borehole to 10.00m bgl and completion of 4no. hand excavated trial pits, with sampling of soil for laboratory testing (see **Figure 2**).

Groundwater and ground gas monitoring was undertaken following completion of the fieldworks on 3rd August 2022.

Details of the ground investigation completed, along with the findings of the investigation, are provided in the following sections. The exploratory hole log and laboratory results are presented in **Appendix D, E and F** respectively.

Guidance Documents

Details of the best practice guidance documents and reference information used in undertaking the ground investigation and assessment are provided at the end of this report (see REFERENCES & GUIDANCE).

INVESTIGATION STRATEGY

The ground investigation was designed based on the requirements of the Consultant Engineers set out in the email specification and associated drawings.

Field Headspace Screening

Field screening of soil samples was undertaken using a *mini-rae Lite* photo ionisation detector (PID). Soil arisings were collected at regular intervals and placed in sealed plastic bags, agitated by shaking and left for a minimum of 15 minutes prior to testing of 'headspace' using the PID.

Soil Chemical Analysis & Laboratory Testing

Soil samples were submitted to the UKAS and MCERTS accredited laboratories of i2 Analytical for chemical analysis and geotechnical testing.

The results of the geotechnical and chemical analysis (including waste acceptance criteria testing) are presented in **Appendix E and F** respectively.

GROUND INVESTIGATION & FINDINGS

GROUND & GROUNDWATER CONDITIONS

Ground Conditions

The table below provides a summary of ground conditions encountered with full descriptions provided in the associated exploratory hole logs provided in **Appendix D**:

Strata	Depth Range to Top (m bgl)	Depth Range to (Base (m bgl)	Summary Description
Made Ground	Ground Level	0.44 – 1.00	The ground surface was found to comprise concrete hard standing. The Made Ground soils were typically found to comprise a slightly ashy gravelly sand and a slightly gravelly clay with varying proportions of brick and concrete gravel. In BH1 location clinker gravel was observed.
Possible Head Deposits ⁽¹⁾	0.44 – 1.00	1.10	Found to comprise a soft Clay with rare flint gravel.
London Clay Formation ⁽²⁾	1.10	10.00	The London Clay was typically found to comprise an upper sequence of soft to firm clay (1.10-1.60m) overlying firm to stiff fissured clays.

(1) Only encountered in BH1.

(2) Base not determined.

Visual and Olfactory Observations

Potential visual and olfactory evidence of contamination was limited clinker observed in BH1 (0.25m). However, Made Ground soils were encountered and can be indicative of the presence of contaminants.

Groundwater Conditions

No groundwater was recorded during the ground investigation works or during the return monitoring.

Where groundwater is recorded within the London Clay Formation during monitoring, rather than being representative of a permanent and laterally continuous aquifer unit, the groundwater is present as discrete units within (for example) micro fissures and local mudstone horizons and the recorded groundwater level will most likely be reflective of the pore water pressures within these discrete features.

GROUND INVESTIGATION & FINDINGS

Soil Infiltration

The London Clay Formation in the London Basin typically comprises low permeability clay soils and reference to the CIRIA SUDS Manual and BGS data confirms that coefficients of infiltration through these soils are very low c. 2.60×10^{-4} to $2.60 \times 10^{-6} \text{m/d}^2$. As such the London Clay soils are unlikely to be suitable media for infiltration drainage (SuDS).

Characteristic Values of Soil Parameters

A summary of the geotechnical properties of the strata based on the field and laboratory testing is provided in the table below.

Soil Property	Stratum	
	Made Ground	London Clay
SPT 'N' Value	-	7 – 32
Undrained Shear Strength via shear vane (kN/m^2)	-	40 – 112
Bulk Density (mg/m^3)	-	1.83 – 2.35 ⁽¹⁾
Moisture Content (%)	13 – 18	29 -30
Plasticity Index (%)	-	42 – 44
pH	8.0	8.3
Sulphate (g/l)	0.34	0.54

(1) Literature values taken from Forster (1997)

² British Geological Survey (BGS), WN97/27. (Forster, 1997). The Engineering Geology of the London Area & SUDS Manual.

GEOTECHNICAL ADVICE

Geotechnical Advice

INTRODUCTION

The site currently comprises a single storey garage. It is understood that the client wishes to construct a three-storey residential property with basement level over part of the proposed building footprint (plant room and storage).

Based on the information provided the following assumptions have been made:

- The formation level of the new partial basement will be approximately 3.0m beneath existing ground floor level.
- The load from the existing structure will be in the region of 10kN/m².
- The load from the proposed developed structure (including lowered basement) will be in the region of 50-60kN/m².
- There will be no significant changes in elevation over the proposed lower ground floor development.
- Foundations will not be eccentrically loaded.

GROUND CONDITIONS SUMMARY AND ENGINEERING PARAMETERS

The ground conditions encountered in the exploratory hole comprise Made Ground overlying a thin layer of possible Head Deposits which in turn overlies sequence of soft to firm becoming firm to stiff fissured clays (London Clay Formation).

No groundwater was recorded during the ground investigation works or during the return monitoring.

FOUNDATION OPTIONS

As outlined, based on the information supplied, the formation level of the new basement will be approximately 3.0m below existing ground floor level. At this depth the formation level will be on the firm London Clay Formation soils, which are considered to be a suitable founding media.

Spread Foundations

Based on the findings of the ground investigation and the subsequent laboratory testing it has been concluded that for traditional spread foundations (placed on the competent firm London Clay) at the assumed formation level of c. 3.0m below existing ground floor level a net safe bearing pressure of 115kN/m² should be available.

The net safe bearing pressure is based on a factor of safety of 3 to ensure that settlement remains within normally acceptable limits. The above advice assumes that the proposed development and in particular foundations would not be within the influence of any trees or tree routes.

GEOTECHNICAL ADVICE

It is recommended that the undrained shear strength of soils at formation level be confirmed using a hand shear vane and should exceed 60kN/m².

Piled Foundations

Based on the proposed development and the ground conditions encountered it is considered unlikely that a piled foundation would be the most feasible solution.

However, it is possible that sheet piling (or similar) may be considered as part of the temporary works. In addition, an assessment of the likely pile capacities has been undertaken purely as an illustration of the feasibility of a piled solution and possible pile capacities.

A factor of safety (FOS) of 3.0 has been adopted in the following preliminary pile assessment. A lower FOS may be adopted but this will require preliminary and working pile tests and the approval of the local District Surveyor.

Based on the ground investigation data the following preliminary appraisal of pile capacities is provided and should be confirmed and/or amended by a competent piling contractor.

Founding Depth (m)	Pile Diameter (mm)	Safe Working Load (kN)	Founding Stratum
10	300	117	Made Ground, possible Head Deposits & London Clay Formation
	450	190	

GROUND STABILITY & RETAINING STRUCTURES

Retaining walls constructed in open cut would be the preferred solution but given the size of the excavation and the adjacent and nearby residential structures it is considered likely that temporary support will be required for construction.

Groundwater was not encountered above formation level but the stability of unsupported excavations at the site should not be relied upon. Zones loosened by the removal of existing and relict construction may be particularly unpredictable and liable to collapse.

It may be beneficial to install the retaining wall and floor slab sequentially to provide propping and lateral restraint, which could help to minimise deflections. It is likely that this will need to be given particular consideration beneath the party walls of the adjoining properties.

Safe working conditions should be ensured where persons are required to work in excavations. It is recommended that reference be made to CIRIA Report No. 97, "Trenching Practice" 1992.

The parameters presented in the table below may be considered to assist with the design of retaining walls.

GEOTECHNICAL ADVICE

Strata	Depth Range (m bgl)		Effective Angle of Shear Resistance ⁽²⁾	Coefficient of Active Earth Pressure (Ka) ⁽²⁾	Coefficient of Passive Earth Resistance (Kp) ⁽²⁾	Bulk Density
	Top	Base				
Made Ground	Ground Level	0.44 – 1.00	27	0.35	3.5	1.70 ⁽¹⁾
Possible Head Deposits	0.44 – 1.00	1.10	22	0.37	3.0	1.80 ⁽¹⁾
London Clay	1.10	10.00	22	0.42	2.7	1.83 – 2.35 ⁽³⁾

(1) Assumed value based on literature information.

(2) Based on soil properties and reference to BS8002 & Tomlinson, M.J. (1986) for a free standing wall.

(3) Literature values taken from Forster (1997)

BURIED CONCRETE

In accordance with BRE Special Digest 1 (2005), the results indicate that the following design sulphate classes and Aggressive Chemical Environment for Concrete (ACEC) classes would apply:

Strata	Design Sulphate Class	ACEC Class
Made Ground	DS-1	AC-1
London Clay Formation	DS-2	AC-2

ADDITIONAL CONSIDERATIONS

Existing Structures

It is recommended that any existing buried construction that will underlie the new development is broken out and removed. However, if buried construction (such as existing foundations) are to remain close to the new structure then care should be taken to avoid interaction i.e. to prevent the slab 'breaking its back' over the existing construction.

Potential for Heave, Settlement & Inward Yielding

The laboratory testing on the London Clay Formation suggests that it is typically a high plasticity clay and as such will have relatively high volume change potential.

The removal of the overburden during the excavation of the lower ground floor is likely to result in some heave and inward yielding of the soils at formation level and possibly a subsequent settlement of the soils outside the excavation. Based on the ground investigation data, the London Clay at formation level is anticipated to comprise firm clay and so the potential effects maybe limited by their relatively low compressibility (as

GEOTECHNICAL ADVICE

compared to soft clay soils). Inward yielding in firm to stiff clays is typically in the range of 5-40mm (Tomlinson, M.J. (1986).

The total uplift will be a function of the soil heave pressure and water pressure, it is anticipated that almost half of this will be immediate upon excavation, while the remainder would be long term. The estimated depth of excavation is 3.0m below current ground level, assuming an unsaturated unit weight of 20kN/m³ and accounting for groundwater within the London Clay, the estimated unload due to the excavation would be in the order of 60kN/m².

It is anticipated that following excavation and construction of the lower ground floor, the load imposed by the new sub-structure will be less than the overburden pressure at formation prior to excavation.

However, it is anticipated the lower ground floor slab would not be loaded if strip footings are adopted. In this case a suspended floor slab may be appropriate, constructed with suitable compressible void formers that can accommodate the expected ground heave.

Based on the information presented above it is recommended that the design takes into account the following:

- The potential for short term and long term heave and inward yielding during construction and following construction.
- The potential for differential heave that will occur in the areas of the excavation beneath the existing building footprint and those limited areas outside the building footprint.

Management of Formation Level

Should pockets of inferior material be present during the inspection of the foundation excavation, they should be removed and replaced with well graded, well compacted hardcore or lean mix concrete. The excavated surface should be protected from deterioration and a blinding layer of concrete used where foundations are not completed without delay. Any surface or perched water should not be allowed to collect in the base of excavations since the clay is prone to rapid deterioration in the presence of water, with loss of their favourable bearing properties.

Groundwater & Groundwater Management

Significant dewatering is not anticipated during the construction of these foundations but some groundwater seepages and/or surface water infiltration into the excavation should be anticipated. It is anticipated that any seepages or rates of inflow of groundwater would be slow and it is recommended that seepages be dealt with by pumping from sumps.

GEOTECHNICAL ADVICE

Potential Project Risk

It should be noted that the excavation of the lower ground floor may undermine the adjacent property and could lead to settlement in gardens and damage to buildings and below ground services. It is recommended that the contractor should allow for suitable mitigation measures that may include:

- A survey of existing ground levels and buildings;
- A survey of existing below ground services;
- Monitoring of adjacent buildings during construction; and
- Monitoring of adjacent ground levels during construction.

ASSESSMENT OF SOIL ANALYTICAL RESULTS

Assessment of Soil Analytical Results

INTRODUCTION

The proposed partial single storey basement will require an excavation of approximately 3.00m beneath the existing building footprint. As such, a large proportion of the Made Ground soils at the site will be removed to facilitate development and the soil sampling and analysis has primarily been undertaken to aid in waste soil disposal.

WASTE CHARACTERISATION

The Landfill (England and Wales) Regulations (2002, as amended), the Hazardous Waste (England and Wales) Regulations (2005, as amended) and the Waste (England and Wales) Regulations (2011) have changed the way in which waste materials have traditionally been managed (i.e. landfill disposal). If materials are to be discarded from site, appropriate characterisation and classification are required prior to disposal, to determine whether a waste should be described as either non-hazardous or hazardous. The process of classification is based around the List of Wastes (England) Regulations in conjunction with the Environment Agency Guidance Document WM3 (edition 1 v.1.1.GB, 2021). Waste Acceptance Criteria (WAC) are often confused as a means of classification when, in actuality, they represent criteria that wastes must satisfy for disposal in target landfill types (i.e. non-hazardous waste may be described as inert if it satisfies the appropriate WAC; however, hazardous waste can never be classified as inert even if it satisfies the WAC for an inert landfill).

Certain categories of waste material are termed 'absolute entries' within the List of Wastes Regulations (2005) and are automatically classified as inert or hazardous e.g. glass packaging and acid tars respectively.

Source of Potential Wastes

The waste materials on site are considered to comprise the Made Ground soils that occupy (typically) the upper 0.50m to 1.00m below ground level.

The source of the Made Ground materials is not known but based on the ground conditions encountered it appears to primarily comprise reworked and possible demolition material that is considered to have been derived from historical, local demolition and construction and possibly reworking of the natural soils in the area of the existing property.

ASSESSMENT OF SOIL ANALYTICAL RESULTS

PRELIMINARY WASTE CHARACTERISATION

Made Ground

On a purely visual basis, the majority of the Made Ground would appear to conform with 'soils and stones' excluding topsoil, peat and excluding soil and stones from contaminated sites (European Waste Catalogue Code 17 05 04). However, where soil and stones are not automatically classified as inert they will always be treated as so called 'mirror entries' of the List of Waste Regulations (European Waste Catalogue Code 17 05 03 mirror hazardous or 17 05 03 mirror non-hazardous). An assessment of the composition of the soil is required to determine the concentrations of potentially dangerous substances that maybe present in the soils to allow the waste to be classified accordingly.

As such, chemical analysis has been completed on two samples of Made Ground (BH1 & TP4) in general accordance with the Environment Agency document Disposal of Waste to Landfill (ref. <https://www.gov.uk/guidance/dispose-of-waste-to-landfill>, January 2020). The results have been used to aid in basic waste characterisation utilising the information presented within the WM3 document for Hazardous wastes.

In addition, the samples of Made Ground were tested for the presence of Asbestos Containing Materials with none detected.

Reference to the WM3 document suggests that the majority of the Made Ground materials will be listed as non-hazardous wastes. Any basic waste characterisation will need to be confirmed by the receiving facility.

Natural Ground Deposits

The natural soils (London Clay Formation) are likely to be listed as inert (soils and stones, European Waste Catalogue Code 17 05 04), again this will need to be confirmed by the receiving landfill facility.

In addition, given the scarcity of inert landfill cells it may be more appropriate (depending on timescales and feasibility etc) to source an alternative use for the soils (such as fill materials or daily cover) or to dispose to non-hazardous landfill.

Waste Acceptance Criteria (WAC) Testing

WAC testing has been undertaken on a sample of Made Ground collected from BH1 (0.60m), with the results presented in **Appendix F**. The results indicate that Made Ground soils would meet non-hazardous waste landfill waste acceptance criteria.

ASSESSMENT OF SOIL ANALYTICAL RESULTS

GENERIC QUANTITATIVE RISK ASSESSMENT

This section provides a preliminary Generic Quantitative Risk Assessment (GQRA) that considers the shallow soil horizons. No statistical analysis has been completed and recorded concentrations have been compared directly to 'Suitable 4 Use Levels' (S4ULs) considering a residential (without home grown produce) end use.

The LQM/CIEH 'Suitable 4 Use Levels' (S4ULs) applied have been developed in accordance with developments in UK human health risk assessment since 2009, in particular the additional land uses and exposure assumptions presented in Defra's C4SL guidance. The S4ULs are all based on Health Criteria that represent minimal or tolerable levels of risks to health as described in the Environment Agency's SR2 guidance, ensuring that the resulting assessment criteria are 'suitable for use' under planning.

Assessment of Potential Risks to Future Site Users (Soil Contamination)

The soil sampling and chemical analysis has included two samples of the Made Ground (BH1 & TP4 at 0.20m) and one sample of the natural soils (BH1 at 4.0m) and was aimed at aiding in waste soil disposal and assessing potential residual soil concentrations post development.

The majority of the recorded concentrations of determinands were found to be either below the limit of detection for the laboratory method applied (<LOD) or below relevant S4UL criteria considering a conservative residential (with home grown produce) end use.

The exception was the recorded concentration of Lead in the sample of Made Ground collected from TP4 (0.20m) which was slightly elevated compared to the S4UL (340mg/kg compared to 310mg/kg). However, the Made Ground soils in this horizon will be removed for off-site disposal to enable development and the recorded residual soil concentrations (BH1 at 4.00m) are low and below the relevant S4ULs.

In addition, the samples of Made Ground soils were screened for (Asbestos Containing Materials) with no ACM detected.

The assessment completed suggests that potential risks are very low. However, the following recommendations are provided:

- A watching brief should be maintained during the development to confirm the presence of any latent areas of contamination.
- If soils are to be imported for use on site (e.g. garden or landscape areas) they should be sampled and analysed to ensure suitability for use.
- As outlined in the Preliminary Risk Assessment (PRA) section of the report, the basement construction is likely to remove a significant portion of potentially impacted soil and it is considered unlikely that upgraded water pipe material will be required. However, confirmation with the statutory undertaker is recommended.

ASSESSMENT OF SOIL ANALYTICAL RESULTS

PRELIMINARY GROUND GAS & VOLATILE VAPOUR RISK ASSESSMENT

A preliminary ground gas risk assessment based on one round of monitoring has been completed to assess potential risks associated with bulk ground gases (carbon dioxide and methane) and volatile vapours to future site users and buildings.

The assessment has been undertaken with reference to the guidance in CIRIA Report C665, BS8576:2013, BS8485:2015, NHBC guidance and The VOCs Handbook, as appropriate (see **Error! Not a valid bookmark self-reference.**).

The results of the monitoring completed on 6th January 2022 are summarised in the table below:

Exploratory Hole	Screened Lithology (Depth m bgl)	Max CH ₄ (% v/v)	Max CO ₂ (% v/v)	O ₂ (% v/v)	Max Flow Rate (l/hr)	Gas Screening Value (l/hr)
BH1	Made Ground & London Clay	<0.10	1.50	19.00	<0.10	<0.07 ⁽¹⁾ (CO ₂)

(1) Gas screening value threshold between very low risk and low risk

Review of the monitoring data indicates that it was completed during dry, cold and clear weather conditions and a period of relatively high atmospheric pressure (1014mb).

Based on the one round of monitoring completed the ground gas risk is consistent with Characteristic Situation 1 (CIRIA, CS1) or Green (NHBC). However, current best practice guidance recommends further monitoring to confirm the ground gas regime.

Volatile Vapour Risk

Field headspace testing completed as part of the ground investigation works recorded PID concentrations of between 0.10 and 2.80ppm. The recorded concentrations are not considered to be indicative of volatile organic contamination of soils.

Concentrations of volatile vapours were recorded <1.50ppm during the single round of monitoring completed. This suggests that potential risk associated with volatile vapours are very low.

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REFERENCES & GUIDANCE

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³ This document has been withdrawn but is considered to remain useful in providing technical background for designing ground investigation works.

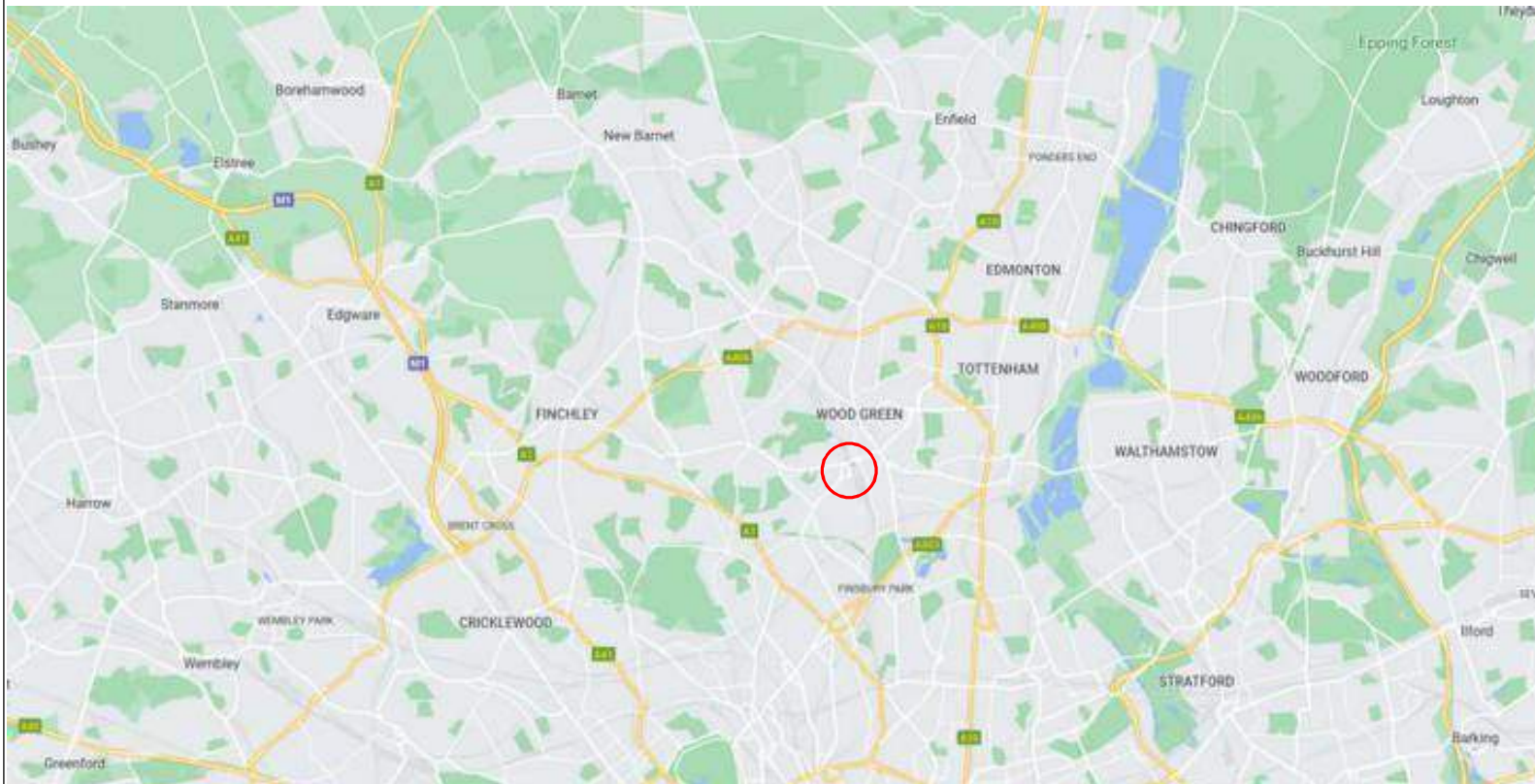
⁴ This document has been withdrawn but is considered to remain useful in providing technical background for designing ground investigation works.

REFERENCES & GUIDANCE

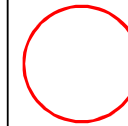
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FIGURES

FIGURES



Key:



Approximate site location

IMPORTANT – Please Read

This drawing is for illustrative purposes only and is for use only in conjunction with associated reports relating to the project details below. LMB accepts no liability for the misinterpretation or use of this illustration by any other parties.



Site:

1 Ferrestone Road, London N8

Figure Number: Figure 1

Title: Site Location Plan

Project No:	Created By:	Date:
	PIL	Sept 2022

Client: Mr Jonas Grau



Key:

 BH Approximate Borehole location

 TP Approximate Trial Pit location

IMPORTANT – Please Read

This drawing is for illustrative purposes only and is for use only in conjunction with associated reports relating to the project details below. LMB accepts no liability for the misinterpretation or use of this illustration by any other parties.



Site:
1 Ferrestone Road, London N8

Figure Number: Figure 2

Title: Exploratory Hole Location Plan

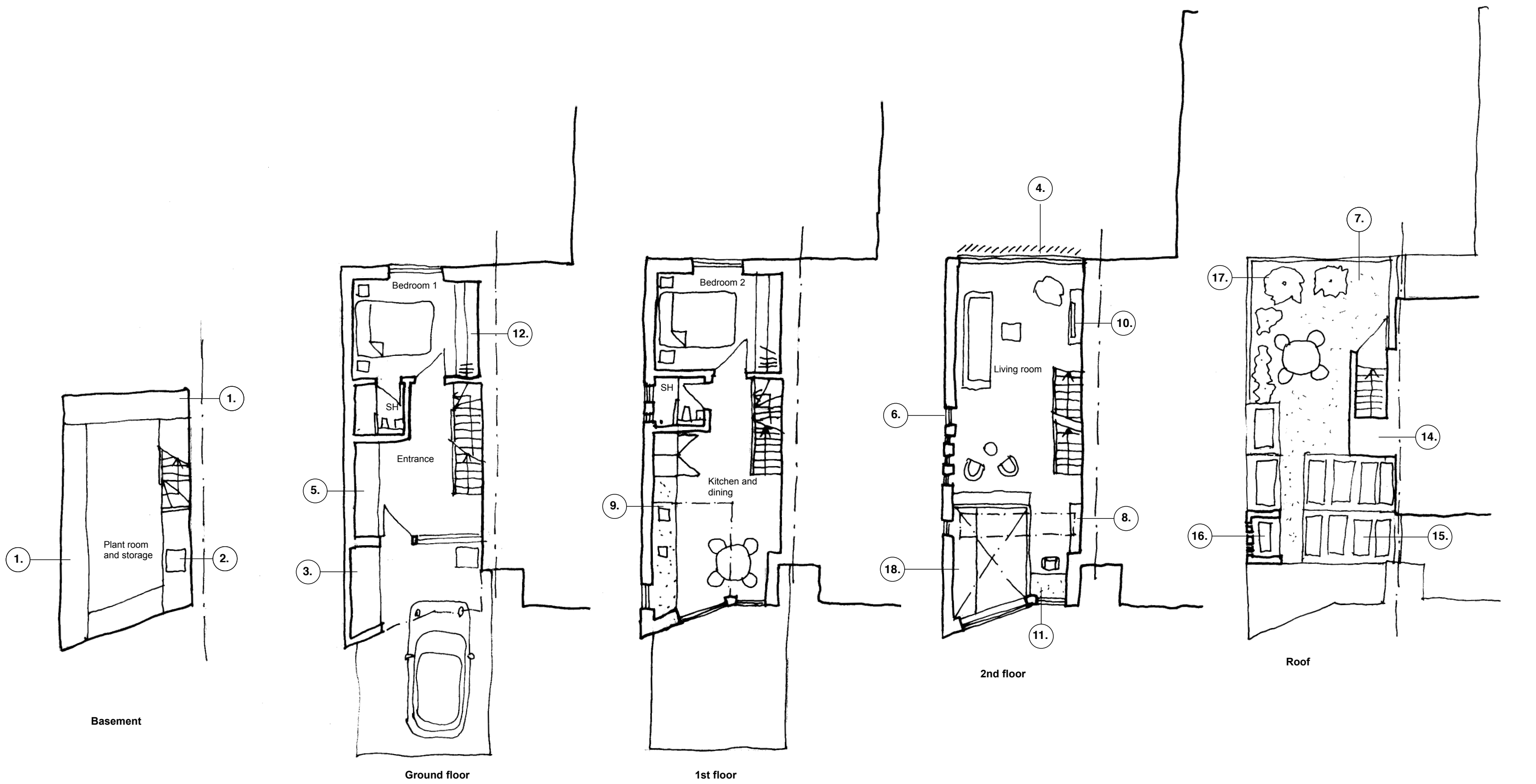
Project No:	Created By: PIL	Date: Sept 2022
--------------------	---------------------------	---------------------------

Client: Mr Jonas Grau

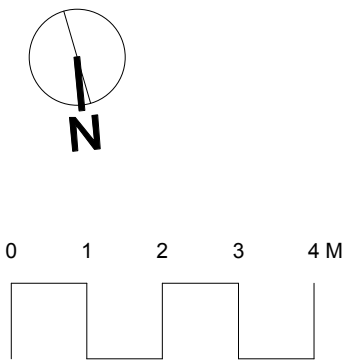
APPENDICES

Appendices

APPENDIX A DEVELOPMENT SCHEMATIC



- Key:
- | | | | |
|-----|-----------------------------|-----|-------------------------------------|
| 1. | Storage | 13. | Not used |
| 2. | Bin lifts | 14. | Staircase enclosure |
| 3. | Cycle storage | 15. | Solar panels with north light under |
| 4. | Solar louvres | 16. | Air source heat pump |
| 5. | Cloaks | 17. | Planting |
| 6. | Windows with obscured glass | 18. | Double height space |
| 7. | Terrace | | |
| 8. | Library/display | | |
| 9. | Kitchen run | | |
| 10. | TV | | |
| 11. | Desk | | |
| 12. | Wardrobe | | |



Revisions:

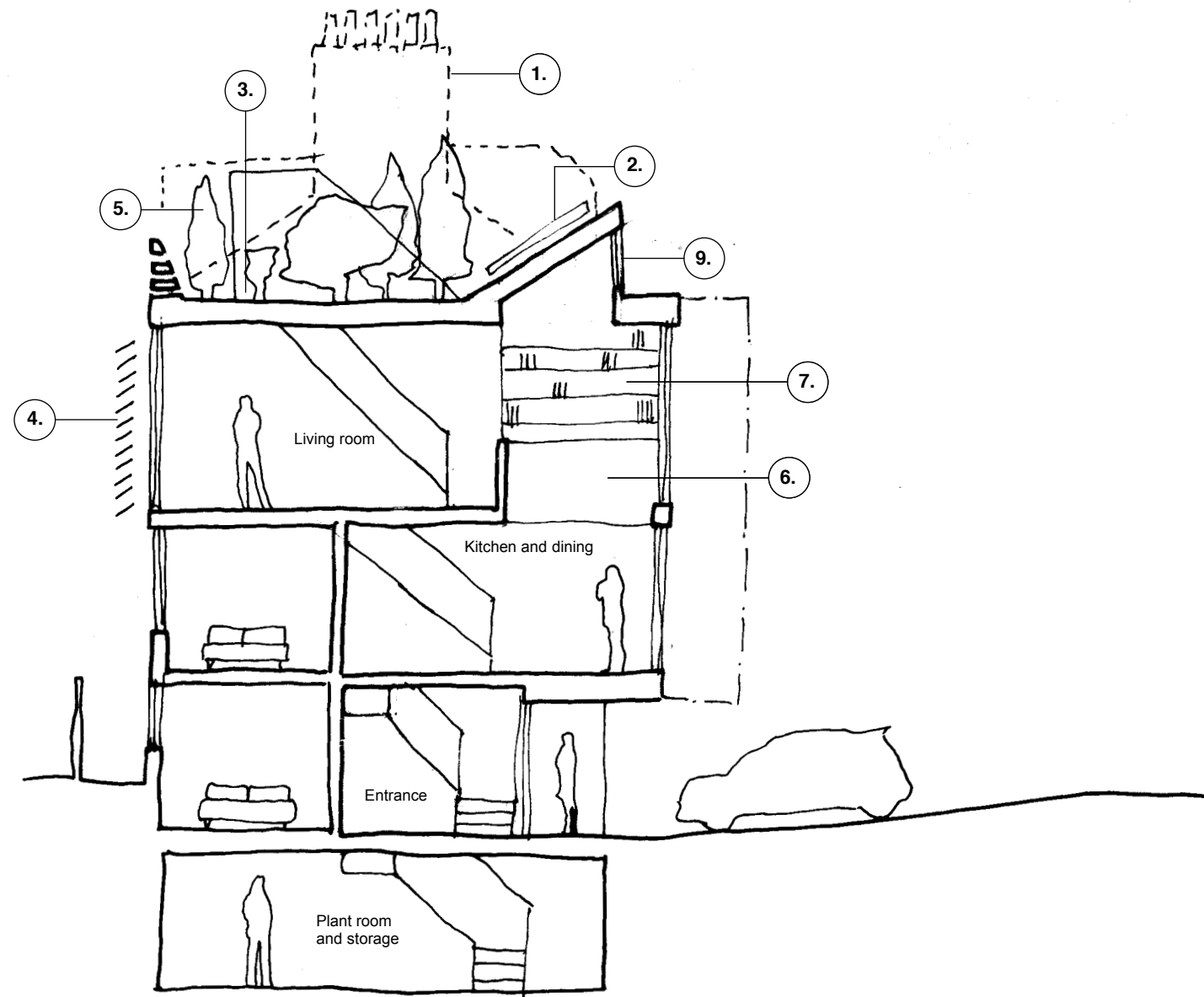
A 22.03.2033 Revised for Pre-App

Pre-App stage	
FER SK06	Proposed pans
Scale 1:100 @ A3	Garage on Ferrestone Road N8 7BX
February 2022	

Appleton Weiner

19 Wallace Road London N1 2PG
Telephone 020 7253 8387

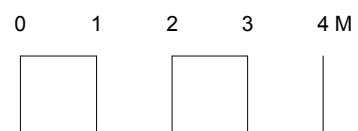
ALL DIMENSIONS TO BE CHECKED ON SITE.
DISCREPANCIES TO BE REFERRED TO APPLETON WEINER.
DO NOT SCALE OFF THIS DRAWING.
ALL DRAWINGS RETAIN APPLETON WEINER COPYRIGHT ©



Section

Key:

- 1. Outline of no. 1 Ferrestone Road
- 2. Solar panel
- 3. Terrace
- 4. Solar louvres
- 5. Planting
- 6. Double height space
- 7. Library/display
- 9. North light



Pre-App stage	
FER SK07	Proposed section Garage on Ferrestone Road N8 7BX
Scale 1:100 @ A3	
February 2022	
Appleton Weiner	
19 Wallace Road London N1 2PG Telephone 020 7253 8387	
ALL DIMENSIONS TO BE CHECKED ON SITE. DISCREPANCIES TO BE REFERRED TO APPLETON WEINER.	
DO NOT SCALE OFF THIS DRAWING. ALL DRAWINGS RETAIN APPLETON WEINER COPYRIGHT ©	

APPENDICES

APPENDIX B PHOTOGRAPHIC RECORD



Plate 1 – front of garage building



Plate 2 – Western side of garage building



Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Photographic Record

Project: Ferrestone
Road

Plates 1 & 2



Plate 3 – internal area of garage (third party supply)



Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Photographic Record

Project: Ferrestone
Road

Plate 3

APPENDICES

APPENDIX C RESPONSES FROM BELOW GROUND ASSET HOLDERS

philip@lmbgeosolutions.com

From: CRL_Safeguarding <CRL_Safeguarding@tfl.gov.uk>
Sent: 03 August 2022 14:38
To: 'Philip Lewis'
Subject: RE: Proposed Basement Development, Garage adjacent to 1 Ferrestone Road, London N8 7BX

Please note,

The Elizabeth line (Crossrail) is not affected by these works.

Best regards,

Will Orlik
Safeguarding Officer (Crossrail)
CRL_Safeguarding@tfl.gov.uk

Infrastructure Protection Team
Floor 7 B5 : 5 Endeavour Square : London : E20 1JN

From: Philip Lewis <philip@lmbgeosolutions.com>
Sent: 03 August 2022 12:36
To: Location Enquiries <SMBLocationEnquiries@tfl.gov.uk>; LULHVpowerassets <LULHVpowerassets@tfl.gov.uk>; OPburiedse@networkrail.co.uk; CRL_Safeguarding <CRL_Safeguarding@tfl.gov.uk>
Subject: RE: Proposed Basement Development, Garage adjacent to 1 Ferrestone Road, London N8 7BX
Importance: High

Dear Sir/Madame

Our client will be developing the property at the above address including a basement and we would be interested in finding out if you hold any below ground assets in the nearby vicinity.

I have attached a location plan for your information.

Best regards,

Philip Lewis
Bsc (Hons), Msc, FGS, CGeol
Director
LMB Geosolutions Ltd
Tel. +44 7739735097

[Home - LMB Geosolutions Ltd](#)

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Linked 



*Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology*

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From: LULHVpowerassets@tfl.gov.uk
Sent: 04 August 2022 12:45
To: philip@lmbgeosolutions.com
Subject: NRSWA Request Response - Your Reference Garage adjacent to 1 Ferrestone Road, N8 7BX

Our Ref: **LKGSW4NP**
Your Ref: **Garage adjacent to 1 Ferrestone Road, N8 7BX**
Date: 04 August 2022

Name: **Philip Lewis**
Company Name: **LMB Geosolutions Ltd**

Dear Sir/Madam

We acknowledge receipt of your Letter / New Roads & Street Works Act Enquiry dated **03/08/22** relating to the following enquiry:

Proposed Basement Development, Garage adjacent to 1 Ferrestone Road, London N8 7BX

We have no H.V. cables or cable duct routes in the immediate area in question. Please note that we only manage High Voltage, Pilot and Fibre Optic Cables for the London Underground distribution network.

Yours sincerely,

On Behalf of the H.V. Cables Manager

Title: NRSWA co-ordinator

Email: **LULHVpowerassets@tfl.gov.uk**

London Underground
Power Distribution
Units 7 & 8, Station Road
Drawing Office
Tufnell Park
London
N19 5UW
Tel: 0203 054 8418/0203 054 8354

This message has been scanned for malware by Forcepoint. www.forcepoint.com

From: Location Enquiries <SMBLocationEnquiries@tfl.gov.uk>
Sent: 15 August 2022 11:30
To: Philip Lewis
Subject: RE: Proposed Basement Development, Garage adjacent to 1 Ferrestone Road, London N8 7BX

Good Morning philip,

Thank you for your enquiry.

I can confirm that London Underground/DLR has no assets within 50 metres of your site as shown on the plan you have provided.

If I can be of further assistance, please contact me.

Kind regards

Adrian Orriss EngTech MICE

Safeguarding Engineer (LU+DLR)

Infrastructure Protection

Email: SMBLocationEnquiries@tfl.gov.uk

TfL Engineering | 5 Endeavour Square, Stratford, London E20 1JN



From: Philip Lewis <philip@lmbgeosolutions.com>
Sent: 03 August 2022 12:36
To: Location Enquiries <SMBLocationEnquiries@tfl.gov.uk>; LULHVpowerassets <LULHVpowerassets@tfl.gov.uk>; OPburiedse@networkrail.co.uk; CRL_Safeguarding <CRL_Safeguarding@tfl.gov.uk>
Subject: RE: Proposed Basement Development, Garage adjacent to 1 Ferrestone Road, London N8 7BX
Importance: High

Dear Sir/Madame

Our client will be developing the property at the above address including a basement and we would be interested in finding out if you hold any below ground assets in the nearby vicinity.

I have attached a location plan for your information.

Best regards,

Philip Lewis

Bsc (Hons), Msc, FGS, CGeol

Director

LMB Geosolutions Ltd

Tel. +44 7739735097

[Home - LMB Geosolutions Ltd](#)

Connect with me on



*Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology*

LMB Geosolutions Ltd is a private limited company registered in England & Wales.



 please don't print this e-mail unless you really need to

This message has been scanned for malware by Forcepoint. www.forcepoint.com

Philip Lewis

From: Dain Fuller
<Dain.Fuller@networkrail.co.uk> on behalf
of OP Buried Services Enquiries
<OPBuriedServicesEnquiries@networkrail.
co.uk>
Sent: 03 August 2022 12:40
To: Philip Lewis
Subject: RE: Proposed Basement Development,
Garage adjacent to 1 Ferrestone Road,
London N8 7BX

OFFICIAL

Dear Sir/Madam,

With regards to your enquiry, Network Rail does not believe there is any Network Rail owned apparatus or underground services within the area you have defined. As there is always the possibility that new works could be planned and undertaken in this area by Network Rail this information is valid as at today's date and is supplied for general guidance only.

Please be aware that this response is based on Network Rail's records and knowledge and no guarantee can be given regarding accuracy or completeness. CAT scans, safe digging practices (as contained in HSE publications) and other appropriate investigative techniques should always be carried out.

There may be other apparatus or underground services owned or operated by Utility Companies and accordingly you should contact individual utilities for information.

If, in connection with your investigations and/or work, you become aware of Network Rail apparatus or underground services within your area of work, please

ensure these are notified to our Asset Protection team via the following link as a matter of urgency so that appropriate measures for avoidance of risk and damage can be put in place.

Contact details can be found in the following link: [Network Rail Asset Protection Teams](#)

If you require any further clarification on any of the information provided by the team, please contact opburiedservicesenquiries@networkrail.co.uk.

Regards,

Dain Fuller
Worksite Survey Manager



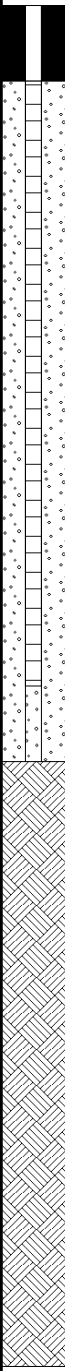
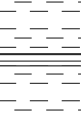
Worksite Survey | Asset Information Services
National Records Centre | Audax Road | York YO30 4US
W: www.networkrail.co.uk

At Network Rail we work flexibly – so whilst it suits me to email now, I do not expect a response or action outside of your own working hours

From: Philip Lewis <philip@lmbgeosolutions.com>
Sent: 03 August 2022 12:36
To: SMBLocationEnquiries@tfl.gov.uk; LULHVpowerassets@tfl.gov.uk; OP Buried Services Enquiries <OPBuriedServicesEnquiries@networkrail.co.uk>; 'CRL_Safeguarding' <CRL_Safeguarding@tfl.gov.uk>
Subject: RE: Proposed Basement Development, Garage adjacent to 1 Ferrestone Road, London N8 7BX
Importance: High

APPENDICES

APPENDIX D EXPLORATORY HOLE LOGS

 Ground Investigation Land Contamination Hydrogeology Engineering Geology					Borehole Log			Borehole No. BH01 Sheet 1 of 1	
Project Name: 1 Ferrestone Road			Project No. LMB_Ferrestone		Co-ords: -		Hole Type IP+WLS		
Location: London N8					Level:		Scale 1:50		
Client: Mr Jonas Grau					Dates: 27/07/2022 - 27/07/2022		Logged By PIL		
Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES	PID=0	0.04			Concrete.	1
		0.60	ES	PID=0	0.50			MADE GROUND: grey to grey brown slightly ashy gravelly Sand. Gravel sub angular fine to medium clinker with occasional brick, flint and concrete.	
		1.00	D	N=7 (1,0/1,2,2,2)	1.00			0.25m layer of old clinker concrete	1
		1.00		PID=1	1.10			Frequent clinker and brick cobbles	
		1.00 - 2.00	L	HVP=40				MADE GROUND: grey to grey brown slightly ashy gravelly Sand. Gravel sub angular fine to medium clinker with occasional brick, flint and concrete.	2
		1.80	ES					0.70m Less gravelly and sandy	
		2.00	D	N=11 (2,2/3,2,3,3)	2.00			Soft brown to grey brown CLAY with rare rounded medium flint gravel. (POSSIBLE HEAD DEPOSITS).	2
		2.00		PID=1				Soft brown with occasional grey and orange brown mottling CLAY with rare rootlets. (LONDON CLAY FORMATION).	
		2.00 - 3.00	L	HVP=60				1.60m Becomes firmer	3
		3.00	D	N=13 (2,2/3,3,3,4)				Firm brown with occasional orange brown mottling CLAY. Some fissuring visible. (LONDON CLAY FORMATION).	
		3.00 - 4.00	L	HVP=65				3.0m Occasional blue grey veining and rare selenite crystals. Closely fissured.	3
		4.00	D	N=17 (3,3/4,4,4,5)	3.80			Stiff brown with blue grey veining CLAY. Very closely fissured. (LONDON CLAY FORMATION).	
		4.00		PID=2				3.80m parting of fine orange silty sand and some selenite crystals.	4
		4.00 - 5.00	L	HVP=72					
		5.00	D	N=18 (3,4/4,4,5,5)				5.50m becomes stiffer.	5
		5.00		PID=2					
		5.00 - 6.00	L	HVP=105				6.70m becomes extremely closely fissured with rare blue grey veining and rare calcarenite nodules.	6
		6.00	D	N=25 (4,5/5,6,7,7)					
	6.00		PID=3				7.45m pyrite nodule.	7	
	6.00 - 7.00	L	HVP=104						
	7.00	D	N=29 (6,6/7,7,7,8)				Weak brown MUDSTONE. (LONDON CLAY FORMATION).	8	
	7.00		PID=1				Stiff to very stiff brown CLAY. Extremely closely fissured. (LONDON CLAY FORMATION).		
	7.00 - 8.00	L	HVP=112	7.60			9.50m becomes darker brown coloured.	9	
	8.00	D	N=30 (6,7/7,7,8,8)	7.68			End of borehole at 9.45 m		
	8.00		PID=1					10	
	8.00 - 9.00	L							
	9.00		N=32 (6,7/7,8,8,9)						
					10.00				

Remarks
Inspection pit: Hand dug

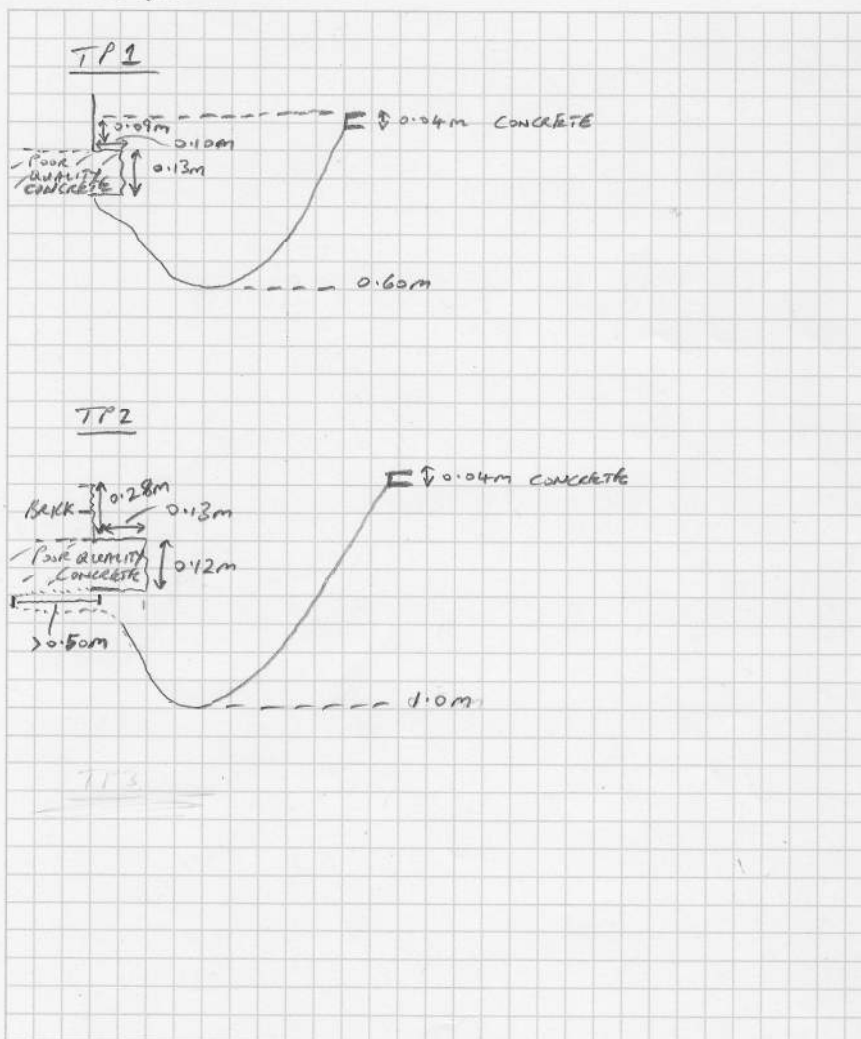


APPENDICES

Project: FERRSTONE ROAD
Description: FOUNDATION TRIAL PIT SECTIONS
Drawn by: FH
Date: 27/7/22

LMB

Ground Investigation
 Land Contamination
 Hydrogeology
 Engineering Geology



APPENDICES

Project: FRANKSTONE RAFT
Description: FOUNDATION TRIAL PIT SECTIONS
Drawn by: PK
Date: 27/7/22



Ground Investigation
 Land Contamination
 Hydrogeology
 Engineering Geology

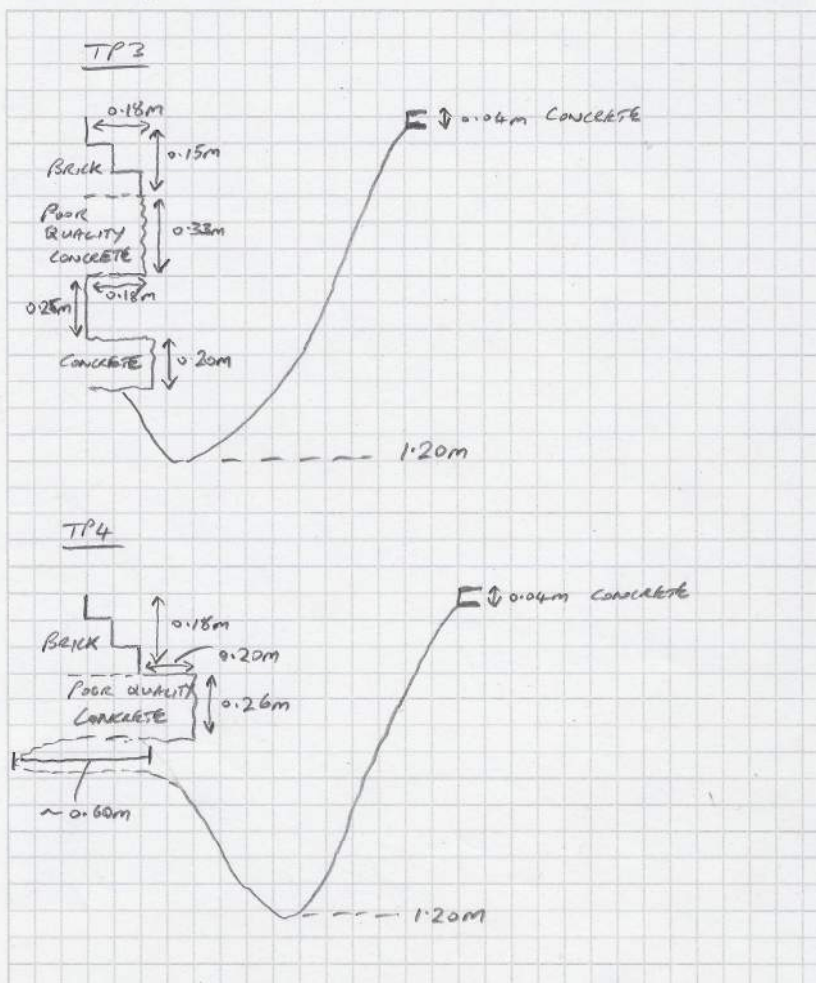




Photo 1 – BH01 arisings (0.00-5.00m)



Photo 2 – BH01 arisings (5.00-10.00m)



Photo 3 – TP01 excavation



Photo 4 – TP02 excavation



Photo 5 – TP03 excavation



Photo 6 – TP04 excavation

APPENDICES

APPENDIX E GEOTECHNICAL LABORATORY RESULTS

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS 1377-2:1990: Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Client: LMB Geosolutions Ltd
Client Address: 28 Dresden Road, London,
N19 3BD

Contact: Philip Lewis
Site Address: Ferrestone Road

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Client Reference: LMB_FERRESTONE

Job Number: 22-74599

Date Sampled: 27/07/2022

Date Received: 28/07/2022

Date Tested: 03/08/2022

Sampled By: Not Given

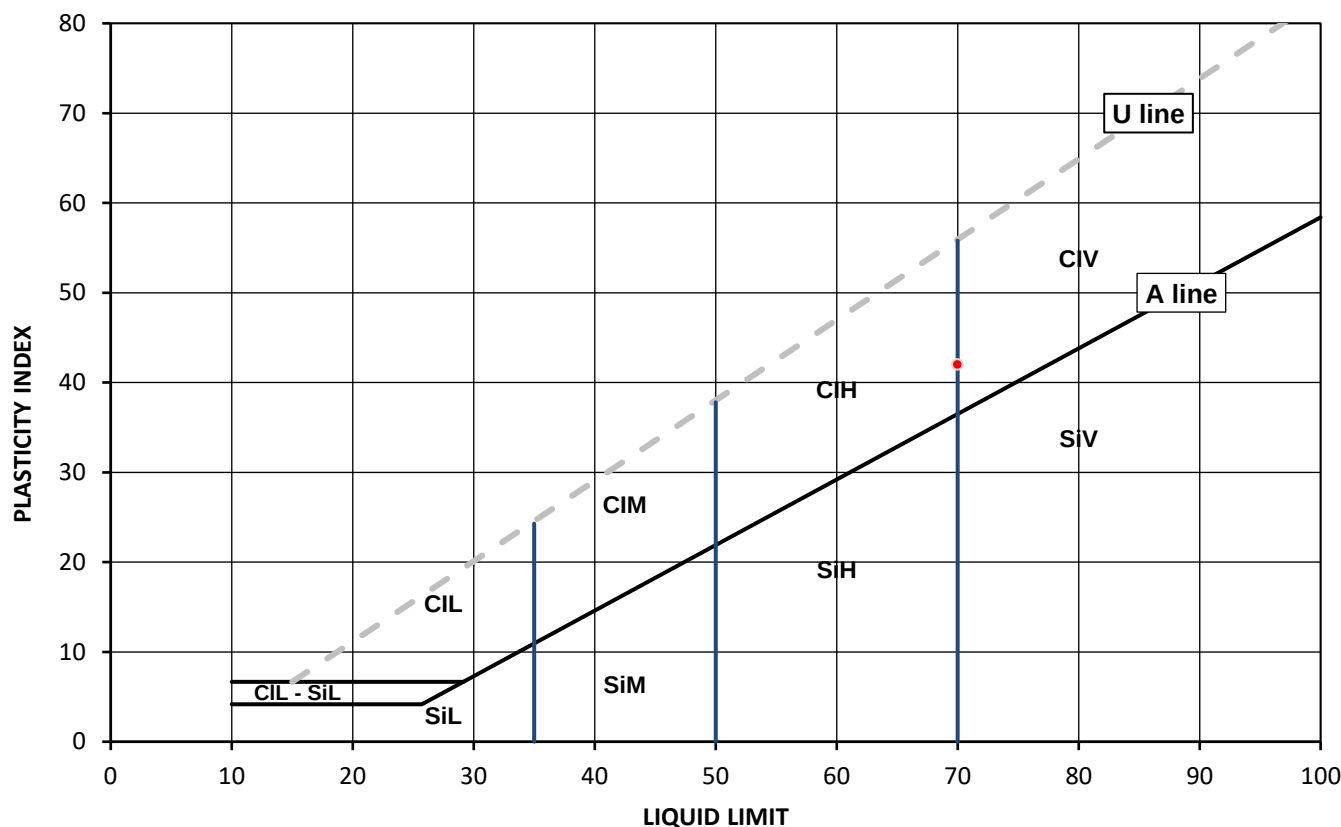
Test Results:

Laboratory Reference: 2369252
Hole No.: BH1
Sample Reference: Not Given
Sample Description: Brown CLAY

Depth Top [m]: 3.00
Depth Base [m]: Not Given
Sample Type: D

Sample Preparation: Tested in natural condition

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	% Passing 425µm BS Test Sieve
29	70	28	42	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

	Plasticity	Liquid Limit
Cl Clay	L Low	below 35
Si Silt	M Medium	35 to 50
	H High	50 to 70
	V Very high	exceeding 70
	O Organic	append to classification for organic material (eg CIHO)

Note: Water Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Katarzyna Koziel
Technical Reviewer
for and on behalf of i2 Analytical Ltd

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS 1377-2:1990: Clause 4.4 and 5

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Client: LMB Geosolutions Ltd
Client Address: 28 Dresden Road, London,
N19 3BD

Contact: Philip Lewis
Site Address: Ferrestone Road

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

Client Reference: LMB_FERRESTONE

Job Number: 22-74599

Date Sampled: 27/07/2022

Date Received: 28/07/2022

Date Tested: 03/08/2022

Sampled By: Not Given

Test Results:

Laboratory Reference: 2369253
Hole No.: BH1
Sample Reference: Not Given
Sample Description: Brown CLAY

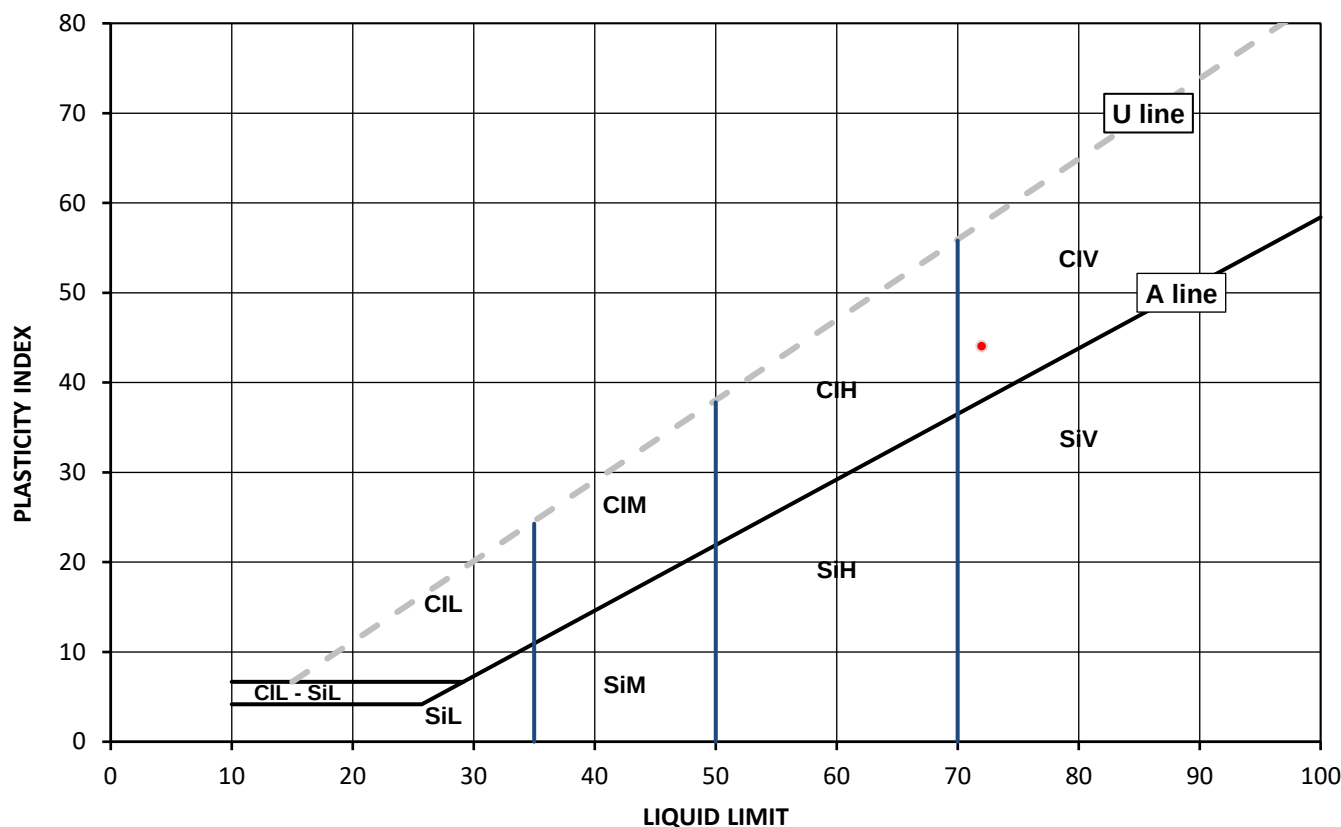
Depth Top [m]: 4.00

Depth Base [m]: Not Given

Sample Type: D

Sample Preparation: Tested in natural condition

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	% Passing 425µm BS Test Sieve
30	72	28	44	100



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

Cl	Clay	Plasticity	L	Low	Liquid Limit	below 35
Si	Silt		M	Medium		35 to 50
			H	High		50 to 70
			V	Very high		exceeding 70
			O	Organic		append to classification for organic material (eg CIHO)

Note: Water Content by BS 1377-2: 1990: Clause 3.2

Remarks:

Signed:

Katarzyna Koziel
Technical Reviewer
for and on behalf of i2 Analytical Ltd

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4041

Client: LMB Geosolutions Ltd
 Client Address: 28 Dresden Road, London,
 N19 3BD

Contact: Philip Lewis
 Site Address: Ferrestone Road

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

SUMMARY REPORT

SUMMARY OF CLASSIFICATION TEST RESULTS

Tested in Accordance with:

Water Content by BS 1377-2:1990: Clause 3.2; Atterberg by BS 1377-2: 1990:
 Clause 4.3 (4 Point Test), Clause 4.4 (1 Point Test) and 5; PD by BS 1377-2:
 1990: Clause 8.2

i2 Analytical Ltd
 Unit 8 Harrowden Road
 Brackmills Industrial Estate
 Northampton NN4 7EB



Environmental Science

Client Reference: LMB_FERRESTONE

Job Number: 22-74599

Date Sampled: 27/07/2022

Date Received: 28/07/2022

Date Tested: 03/08/2022

Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	Water Content BS 1377-2 [W] %	Water Content BS EN ISO 17892-1 [W] %	Atterberg				Density			Total Porosity# %		
		Reference	Depth Top m	Depth Base m	Type					% Passing 425um %	WL %	Wp %	Ip %	bulk Mg/m3	dry Mg/m3	PD Mg/m3			
2369252	BH1	Not Given	3.00	Not Given	D	Brown CLAY	Atterberg 1 Point	29		100	70	28	42						
2369253	BH1	Not Given	4.00	Not Given	D	Brown CLAY	Atterberg 1 Point	30		100	72	28	44						

Note: # Non accredited; NP - Non plastic

Comments:

Signed:

Katarzyna Koziel

Katarzyna Koziel
 Technical Reviewer
 for and on behalf of i2 Analytical Ltd

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4041

Client: LMB Geosolutions Ltd
Client Address: 28 Dresden Road, London,
N19 3BD

Contact: Philip Lewis
Site Address: Ferrestone Road

Testing carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland

SUMMARY REPORT

DETERMINATION OF WATER CONTENT

Tested in Accordance with: BS 1377-2: 1990: Clause 3.2

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB



Environmental Science

Client Reference: LMB_FERRESTONE

Job Number: 22-74599

Date Sampled: 27/07/2022

Date Received: 28/07/2022

Date Tested: 03/08/2022

Sampled By: Not Given

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	WC	Sample preparation / Oven temperature at the time of testing			
		Reference	Depth Top m	Depth Base m	Type							
2369252	BH1	Not Given	3.00	Not Given	D	Brown CLAY		29	Sample was quartered, oven dried at 108.6 °C			
2369253	BH1	Not Given	4.00	Not Given	D	Brown CLAY		30	Sample was quartered, oven dried at 108.6 °C			

Comments:

Signed:

Katarzyna
Koziel

Katarzyna Koziel
Technical Reviewer
for and on behalf of i2 Analytical Ltd

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

APPENDICES

APPENDIX F CHEMICAL LABORATORY TESTING RESULTS

Philip Lewis
LMB Geosolutions Ltd
28 Dresden Road
London
N19 3BD

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

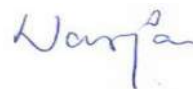
t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

e: philip@lmbgeosolutions.com

Analytical Report Number : 22-74592

Project / Site name:	Ferrestone Road	Samples received on:	28/07/2022
Your job number:	LMB_FERRESTONE	Samples instructed on/ Analysis started on:	28/07/2022
Your order number:		Analysis completed by:	08/08/2022
Report Issue Number:	1	Report issued on:	08/08/2022
Samples Analysed:	3 soil samples		

Signed:



Dominika Warjan
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 22-74592
Project / Site name: Ferrestone Road

Lab Sample Number				2369241	2369242	2369243
Sample Reference				BH1	BH1	TP4
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.20	4.00	0.20
Date Sampled				27/07/2022	27/07/2022	27/07/2022
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	13	16	18
Total mass of sample received	kg	0.001	NONE	1	0.4	0.4

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	-	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	NTK	N/A	NTK

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	-	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	-	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	-	-
Phenanthrene	mg/kg	0.05	MCERTS	0.66	-	-
Anthracene	mg/kg	0.05	MCERTS	0.17	-	-
Fluoranthene	mg/kg	0.05	MCERTS	1.2	-	-
Pyrene	mg/kg	0.05	MCERTS	1.2	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.94	-	-
Chrysene	mg/kg	0.05	MCERTS	0.86	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.4	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.37	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	1	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.59	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.7	-	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	9.13	-	-
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Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	20	17	20
Boron (water soluble)	mg/kg	0.2	MCERTS	0.8	0.3	0.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	2	< 0.2	< 0.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	27	100	40
Copper (aqua regia extractable)	mg/kg	1	MCERTS	89	47	57
Lead (aqua regia extractable)	mg/kg	1	MCERTS	180	34	340
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	0.7
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	33	62	31
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	970	130	180

Petroleum Hydrocarbons

TPH C10 - C40 EH_CU_ID_TOTAL	mg/kg	10	MCERTS	-	< 10	-
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U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 22-74592

Project / Site name: Ferrestone Road

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2369241	BH1	None Supplied	0.2	Brown loam and sand with gravel and rubble.
2369242	BH1	None Supplied	4	Brown clay and loam with gravel.
2369243	TP4	None Supplied	0.2	Brown loam and clay with rubble and brick.

Analytical Report Number : 22-74592
Project / Site name: Ferrestone Road

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
TPH Banding in Soil by FID	Determination of hexane extractable hydrocarbons in soil by GC-FID.	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

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Analytical Report Number : 22-74601

Project / Site name:	Ferrestone Road	Samples received on:	28/07/2022
Your job number:	LMB_FERRESTONE	Samples instructed on/ Analysis started on:	28/07/2022
Your order number:		Analysis completed by:	05/08/2022
Report Issue Number:	1	Report issued on:	05/08/2022
Samples Analysed:	2 soil samples		


Signed:

Dominika Warjan
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 22-74601
Project / Site name: Ferrestone Road

Lab Sample Number				2369256	2369257
Sample Reference				BH1	BH1
Sample Number				None Supplied	None Supplied
Depth (m)				0.60	3.00
Date Sampled				27/07/2022	27/07/2022
Time Taken				None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		
Stone Content	%	0.1	NONE	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	29	17
Total mass of sample received	kg	0.001	NONE	0.7	0.3

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8	8.3
Water Soluble Sulphate as SO ₄ 16hr extraction (2:1)	mg/kg	2.5	MCERTS	690	1100
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.34	0.54
Water Soluble SO ₄ 10hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	343	542

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 22-74601

Project / Site name: Ferrestone Road

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Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2369256	BH1	None Supplied	0.6	Brown clay and loam with gravel.
2369257	BH1	None Supplied	3	Brown clay.

Analytical Report Number : 22-74601
Project / Site name: Ferrestone Road

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.



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Analytical Report Number : 22-74597

Project / Site name:	Ferrestone Road	Samples received on:	28/07/2022
Your job number:	LMB_FERRESTONE	Samples instructed on/ Analysis started on:	28/07/2022
Your order number:		Analysis completed by:	05/08/2022
Report Issue Number:	1	Report issued on:	08/08/2022
Samples Analysed:	1 10:1 WAC sample		

Martyna Langer

Signed:

Martyna Langer
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.



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Waste Acceptance Criteria Analytical Results

Report No:	22-74597						
					Client: LMBGEOSOL		
Location	Ferrestone Road						
Lab Reference (Sample Number)	2369249 / 2369250				Landfill Waste Acceptance Criteria		
					Limits		
Sampling Date	27/07/2022				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID	BH1						
Depth (m)	0.60						
Solid Waste Analysis							
TOC (%)**	2.6				3%	5%	6%
Loss on Ignition (%) **	-				--	--	10%
BTEX (µg/kg) **	-				6000	--	--
Sum of PCBs (mg/kg) **	-				1	--	--
Mineral Oil (mg/kg) ^{EH, ID, CU, AL}	-				500	--	--
Total PAH (WAC-17) (mg/kg)	-				100	--	--
pH (units)**	8.2				--	>6	--
Acid Neutralisation Capacity (mmol / kg)	6.3				--	To be evaluated	To be evaluated
Eluate Analysis	10:1			10:1	Limit values for compliance leaching test		
(BS EN 12457 - 2 preparation utilising end over end leaching procedure)	mg/l			mg/kg	using BS EN 12457-2 at L/S 10 l/kg (mg/kg)		
Arsenic *	0.0035			0.0249	0.5	2	25
Barium *	0.0129			0.0914	20	100	300
Cadmium *	< 0.0001			< 0.0008	0.04	1	5
Chromium *	0.0006			0.0040	0.5	10	70
Copper *	0.010			0.073	2	50	100
Mercury *	< 0.0005			< 0.0050	0.01	0.2	2
Molybdenum *	0.0079			0.0558	0.5	10	30
Nickel *	0.0053			0.037	0.4	10	40
Lead *	0.0040			0.028	0.5	10	50
Antimony *	< 0.0017			< 0.017	0.06	0.7	5
Selenium *	< 0.0040			< 0.040	0.1	0.5	7
Zinc *	0.0089			0.063	4	50	200
Chloride *	2.2			15	800	15000	25000
Fluoride	0.84			6.0	10	150	500
Sulphate *	19			130	1000	20000	50000
TDS*	110			770	4000	60000	100000
Phenol Index (Monohydric Phenols) *	< 0.010			< 0.10	1	-	-
DOC	10.5			74.8	500	800	1000
Leach Test Information							
Stone Content (%)	< 0.1						
Sample Mass (kg)	0.70						
Dry Matter (%)	71						
Moisture (%)	29						
Results are expressed on a dry weight basis, after correction for moisture content where applicable.					**= UKAS accredited (liquid eluate analysis only)		
Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation					** = MCERTS accredited		

Results are expressed on a dry weight basis, after correction for moisture content where applicable.

* = UKAS accredited (liquid eluate analysis only)

Stated limits are for guidance only and i2 cannot be held responsible for any discrepancies with current legislation

** = MCERTS accredited

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes as defined by the Waste (England and Wales) Regulations 2011 (as amended) and EA Guidance WM3.
This analysis is only applicable for landfill acceptance criteria (The Environmental Permitting (England and Wales) Regulations) and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Analytical Report Number : 22-74597

Project / Site name: Ferrestone Road

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Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2369249	BH1	None Supplied	0.6	Brown clay and loam with gravel.

Analytical Report Number : 22-74597

Project / Site name: Ferrestone Road

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
BS EN 12457-2 (10:1) Leachate Prep	10:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-2.	L043-PL	W	NONE
Acid neutralisation capacity of soil	Determination of acid neutralisation capacity by addition of acid or alkali followed by electronic probe.	In-house method based on Guidance an Sampling and Testing of Wastes to Meet Landfill Waste Acceptance"	L046-PL	W	NONE
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH at 20oC in soil	Determination of pH in soil by addition of water followed by electrometric measurement.	In house method.	L005-PL	W	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Metals in leachate by ICP-OES	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil"	L039-PL	W	ISO 17025
Chloride 10:1 WAC	Determination of Chloride colorimetrically by discrete analyser.	In house based on MEWAM Method ISBN 0117516260.	L082-PL	W	ISO 17025
Fluoride 10:1 WAC	Determination of fluoride in leachate by 1:1ratio with a buffer solution followed by Ion Selective Electrode.	In-house method based on Use of Total Ionic Strength Adjustment Buffer for Electrode Determination"	L033B-PL	W	ISO 17025
Sulphate 10:1 WAC	Determination of sulphate in leachate by ICP-OES	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil"	L039-PL	W	ISO 17025
Total dissolved solids 10:1 WAC	Determination of total dissolved solids in water by EC probe using a factor of 0.6.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L004-PL	W	ISO 17025
Monohydric phenols 10:1 WAC	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Dissolved organic carbon 10:1 WAC	Determination of dissolved inorganic carbon in leachate by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	NONE

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For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

APPENDIX D

FLOOD RISK ASSESSMENT

WE ARE SYMMETRYS

FLOOD RISK ASSESSMENT

FERRESTONE ROAD
LONDON
N8 7BX

22135-SYM-XX-XX-RP-C-0001



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APPENDICES

- Appendix A Sewer Records
- Appendix B EA Flood Map for Planning
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REVISION HISTORY

Revision	Description	Date	By	Checked
P1	Draft Issue	20/09/22	YP	RF
P2	Issue for Planning	19/01/23	YP	RF



1.0 Executive Summary

- 1.1 The site is located in Ferrestone Road, Haringey, London, N8 7BX.
- 1.2 The proposed development consists of a three storey over part-basement, four-person house.
- 1.3 The site is classified as 'More Vulnerable', in accordance with the National Planning Policy Framework.
- 1.4 The site is located in Flood Zone 1 and is in an existing residential area. The development should fulfil the requirements of the Sequential Test. The site will provide one of the 2,600 'small site' new homes identified in the London Plan as being required by Haringey.
- 1.5 An Exception Test is not required as the 'More Vulnerable' development lies within Flood Zone 1.
- 1.6 The site lies within a Critical Drainage Area as identified by The LB of Haringey SWMP (Surface Water Management Plan)
- 1.7 The overall flood risk to the site is assessed as 'Low'.
- 1.8 The proposed drainage strategy for the development would provide adequate water management for the site.
- 1.9 An assessment of the feasibility of the sustainable urban drainages (SuDS) has been conducted in accordance with the London Plan's drainage hierarchy. Maximum runoff discharge is limited to 1 l/s for the 1in100 +40% storm event.
- 1.10 The inclusion of flood resistant, resilience and mitigation techniques stated in this Flood Risk Assessment reduce the impact of flooding.

2.0 Introduction

- 2.1 This site-specific Flood Risk Assessment (FRA) has been prepared for the proposed works, which consists of the demolition of existing garage and the erection of a 3-bedroom house with basement.
- 2.2 Architectural drawings can be found in BIA Appendix A – Stage 2 Drawings
- 2.2.1 The proposed development is within a Critical Drainage Area (CDA) hence the purpose of this FRA is to provide information regarding the potential flood risk hazards affecting the site and demonstrate that the development is safe for its intended use.
- 2.3 This FRA has been prepared with reference to the National Planning Policy Framework (NPPF, 2021) and the National Planning Practice Guidance (NPPG, 2022), Haringey Council Strategic Flood Risk Assessment (SFRA) and Surface Water Management Plan (SWMP)

3.0 Scope of Flood Risk Assessment

3.1 National Planning Policy Framework (NPPF)

- 3.1.1 The National Planning Policy Framework (NPPF) was published in March 2012 and sets out the government's planning policies for England and how they are expected to be applied. Chapter 14 'Meeting the challenge of climate change, flooding and coastal change' deals with planning for a low carbon future, taking full account of flood risk and coastal change.
- 3.1.2 Paragraph 161-163 of the NPPF states that all plans should apply a sequential, risk-based approach to the location of the development and manage any residual risk by considering a sequential test, and if necessary, an exception test. The sequential test aims to steer new development to areas with the lowest risk of flooding from any source. If this is not possible, the exception test may have to be applied.
- 3.1.3 Paragraph 167 of the NPPF states that when determining any planning application, the Local Authority should ensure flood risk is not increased elsewhere and, where appropriate, be supported by a site-specific flood risk assessment. In areas at risk of flooding, development should only be allowed if it can be demonstrated that (and in light of the sequential and exception tests, as applicable):

(a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;

(b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;

(c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;

(d) any residual risk can be safely managed; and

(e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

- 3.1.4 Footnote 55 in the NPPF states that a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.
- 3.1.5 The national planning practice guidance to the NPPF was launched as a web-based resource in March 2014. The category dealing with flooding is contained in Flood Risk and Coastal Change, updated on August 2022.
- 3.1.6 Paragraph 30 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-030-20140306) advises that a site-specific flood risk assessment is carried out to assess the flood risk to and from a development site. The assessment should demonstrate how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users.
- 3.1.7 Paragraph 2 in the Flood Risk and Coastal Change Planning Practice Guidance (Reference ID: 7-002-20140306) advises that "flood risk" is a combination of the probability and the potential consequences of flooding from all sources – including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.
- 3.1.8 Paragraph 020 (Reference ID: 7-020-20220825) of the Flood Risk and Coastal Change Planning Practice Guidance gives a checklist for site-specific flood risk assessments and provides the basis of the scope of this FRA.

3.2 Department for Environment, Food & Rural Affairs (DEFRA) and Environment Agency (EA) Guidance

- 3.2.1 Paragraph 32 of the NPPF states that applicants for planning permission (or prior approval in the case of certain permitted development rights) will find the Environment Agency's advice on assessing flood risk for planning applications helpful when preparing a site-specific flood risk assessment for, and before designing, a development that raises lower risk concerns.
- 3.2.2 Guidance from the Department for Environment, Food & Rural Affairs (DEFRA) and Environment Agency (EA), published on the Government's GOV.UK website, includes guidance on how to carry out a flood risk assessment entitled: 'Flood risk assessment in flood zones 2 and 3', 'Flood risk assessment in flood zone 1 and critical drainage areas', and 'Preparing a flood risk assessment: standing advice'. The guidance provides information on the range of factors that need to be considered when assessing flood risk.
- 3.2.3 For Flood Zone 1, the Environment Agency is to be consulted if the development is:
 - (a) within 20m of a main river on the Environment Agency flood map;
 - (b) in an area with critical drainage problems, other than minor development, as classed in the legislation.gov.uk website.
- 3.2.4 Based on the guidance detailed above, the EA has not been consulted for the purposes of this Flood Risk Assessment.



3.3 Level 1 Strategic Flood Risk Assessment (SFRA)

3.3.1 Paragraph 160 of the NPPF states:

“Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.”

3.3.2 A SFRA was prepared by JBA Consulting on behalf of the London Boroughs of Haringey, dated February 2015.. The SFRA provides an overview of flood risk from all sources including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

3.3.3 The SFRA states the following requirements for development proposals:

- show development is not at risk of flooding or is compatible with the residual risk;
- not increase flood risk elsewhere, taking into account the impacts of climate change;
- not increase surface water peak flow rates or runoff volumes above green field levels including an allowance for climate change, as this would result in an increased flood risk to the receiving catchments;
- not increase the risk of groundwater flooding elsewhere or change the hydrogeological regime of the area;
- the location of basement development should be carefully considered within the LB of Haringey and attention should be paid to all sources of flood risk early within the planning process for new development (including the impact of potential future subterranean works that fall under permitted development);
- wherever possible use the opportunities offered by new development to reduce flood risk within the site and elsewhere;
- ensure that where new development is necessary in areas of flood risk (in exceptional circumstances); it is made safe from flooding for the lifetime of the development, taking into account the impacts of climate change. This includes consideration of the potential effect of residual risks.

3.3.4 The following requirements should be included in the FRA :

- There shall be no self-contained basement developments located in areas of fluvial pluvial or groundwater flood risk. Any self-contained developments located in an area shown on the National Reservoir Inundation Maps should include within their FRA, an emergency evacuation plan and should be designed to withstand the forces that might be encountered during breach event of reservoir or flood defences.
- Any development including, basement extensions, shall include within their FRA evidence that flood risk from fluvial, pluvial and groundwater sources are not increased to the development site itself and to third parties.
- Surface water discharge from proposed development sites should mimic that of a present day green field site, up to and including a 1:100 AEP critical storm event including an allowance for climate change. Green field runoff rates should be maintained irrespective of whether the site falls within an area designated as being effected by flood risk from any source.
- It is critical that the onsite drainage models should demonstrate that there is no increased flood risk to third parties. Use SuDS measures wherever practical and achieve 50% attenuation of undeveloped site's surface water runoff at peak times⁶⁴. Exemplar SuDS schemes, should consult

3.4 Proposed Site and Location

3.4.1 The site is located in Ferrestone Road, Hornsey, Haringey. The postcode is N8 7BX and an approximate Ordnance Survey grid reference is 530660 , 189153.

3.4.2 The current site is occupied by a ground floor garage, with a footprint of 32.65 sqm. The total site area is 48.5 sqm, location is shown on Figure 1, below.



Figure 1. Site Location

4.0 Existing Development

4.1 Existing Drainage

- 4.1.1 An asset map has been obtained from Thames Water. it shows two separate 300 dia foul and surface water sewers running along Ferrestone Road. Both networks are approximate 3 m deep at this location. Extract is shown in Figure 2 below, and maps are included in Appendix A.

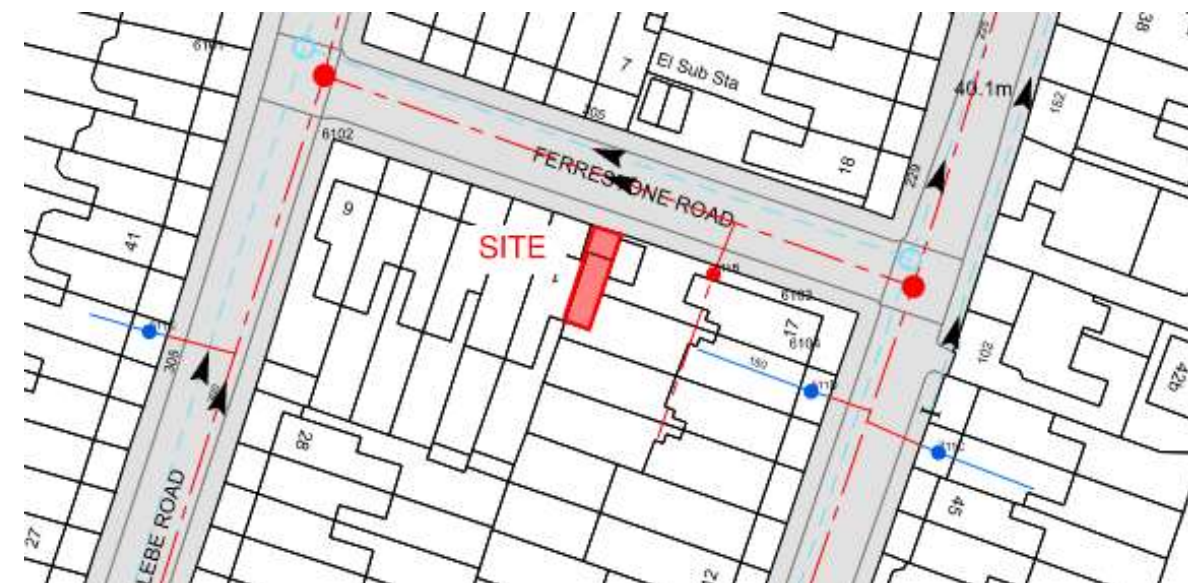


Figure 2. Thames Water Asset Map

4.1.2 There is not known connection from the site to any of the sewers.

4.2 Existing Levels

- 4.2.1 Indicative information from Grid Reference Finder shows Ferrestone Road is generally flat with levels circa 42m aOD. This is consistent with level information included in the SWMP Lidar Representation map.
- 4.2.2 There is a crossover at the front of the site and based on a Google Maps search, levels seem to slope away from the property.

4.3 Geology, Hydrology and Hydro-geology

- 4.3.1 The British Geological Survey© online geological mapping indicates that the site is underlain by bedrock only; London Clay Formation – Clay, Sand and Gravel. There are no superficial deposits recorded for the site.
- 4.3.2 A Ground Investigation & Assessment was conducted by LMB Geosolutions Ltd in August 2022. The full report can be found in BIA Appendix C.. A summary of the ground conditions is as follows:

The ground conditions encountered in the exploratory hole comprise Made Ground overlying a thin layer of possible Head Deposits which in turn overlies sequence of soft to firm becoming firm to stiff fissured clays (London Clay Formation).

- 4.3.3 No groundwater was recorded during the ground investigation works or during the return monitoring.
- 4.3.4 According to the SWMP Overland flow follows the path of the Moselle Brook catchment where the natural outfall has been culverted beneath the railway line and the New River.
- 4.3.5 The Cranfield Soil and AgriFood Institute (CSAI), incorporating the National Soil Resources Institute (NSRI,) at Cranfield University maintains soil reports and maps for England and Wales. The Soilsclapes dataset map, shown in Figure 5 indicates that soils in the area are ‘slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils’ with a ‘loamy and clayey’ texture. These soils are identified as having ‘impeded drainage’.

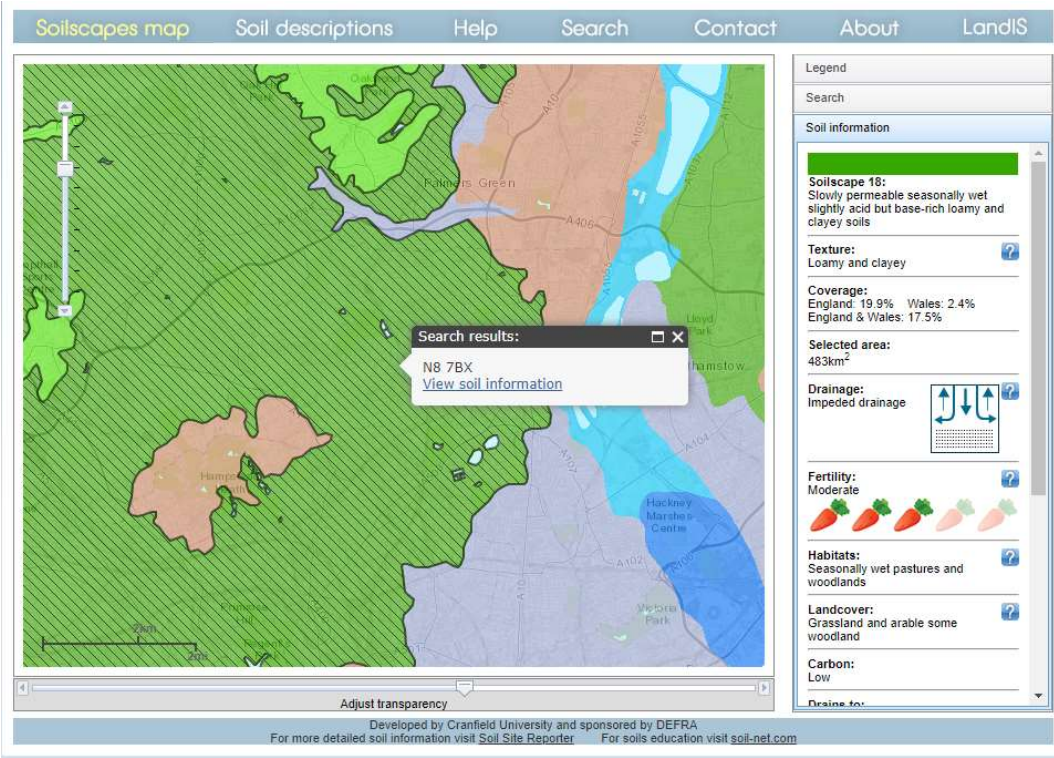


Figure 3. Soilsclapes Map

- 4.3.6 Source Protection Zones (SPZs) are used to provide additional protection to safeguard drinking water quality through constraining the proximity of an activity that may impact upon a drinking water abstraction. From the Environment Agency’s Source Protection Zones dataset on the MAGIC website, the site is not located within A SPZ1. This zone is defined by a travel time of 50-days or less from any point within the zone at, or below, the water table. Additionally, the zone has as a minimum a 50-metre radius. It is based principally on biological decay criteria and is designed to protect against the transmission of toxic chemicals and water-borne disease.
- 4.3.7 Aquifer designation maps dataset identifies different types of aquifer – underground layers of water-bearing permeable rock or drift deposits from which groundwater can be extracted. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The site is at an unproductive area.

5.0 Proposed Development

- 5.1 The proposal consists of a three storey over part-basement, four-person (2b/4p) house (in accordance with Strategic Policies DPD Policy DM14: Self-build and Custom-build Housing). The site will provide one of the 2,600 ‘small site’ new homes identified in the London Plan as being required by Haringey.
- 5.2 Architectural layouts can be found in BIA Appendix A – Stage 2 Drawings

6.0 Flood Risk Vulnerability and Flood Zone ‘Compatibility’

- 6.1 Paragraph 077 (Reference ID: 7-077-20220825) of the Flood Risk and Coastal Change Planning Practice Guidance contains in Annex 3: *Flood risk vulnerability classification*. With reference to Table 2, the proposed development falls into the ‘More vulnerable’. A copy of the More Vulnerable classification from the Table is reproduced below:

NPPG Annex 3: Flood Risk Vulnerability Classification – More Vulnerable
Hospitals
Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels
Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels
Non-residential uses for health services, nurseries and educational establishments
Landfill* and sites used for waste management facilities for hazardous waste
Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan

Figure 4. NPPG Annex 3

- 6.2 With reference to Paragraph 079 (Reference ID: 7-079-20220825) Table 2: *Flood risk vulnerability and flood zone ‘compatibility’*, ‘More Vulnerable’ developments in Flood Zone 1 is appropriate. A screenshot of Table 3 is given below:

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓ *

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Figure 5. NPPG Table 2

6.3 The Sequential Test and Exception Test

6.4 For developments in areas identified as being at risk of any source of flooding now or in the future a sequential is required, Paragraph: 033 (Reference ID: 7-033-20220825) states that if the exception test is not required and the development is made safe through its lifetime, without increasing flood risk elsewhere, the development is appropriate.

6.5 SFRA Basement Development Guidance

6.6 Table 6-2 included in the SFRA and shown in Figure 6 describes the basement property type and recommends whether a type is suitable depending on its location in the Environment Agency Flood Zones, the LB of Haringey SWMP surface water maps and the iPEG maps.

Table 6-2 Basement Property Types and Flood Risk									
Property Type	Type of Development	Fluvial				LB of Haringey SWMP Surface Water Maps			
		FZ3a	FZ3b	FZ2	FZ1	30yr > 0.1m	30yr > 0.3m	200yr > 0.1m	200yr > 0.3m
Type 1	Self Contained Basement Dwelling	✗	✗	✗	✓	✗	✗	✗	✗
	Basement is less than 3 metres depth and does not extend beyond the footprint of the original building.	✓ (i)	✗	✓ (i)	✓ (i)	✓ (i)	✓ (i)	✓ (i)	✓ (i)
Type 2	Householder Application Larger than the dimensions of permitted development; greater than 3 metres in depth and extends beyond 3-4 metres outside of the footprint of the original building.	✗	✗	✓	✓	✓	✓	✓	✓
Type 3	New Building (Usually a new house) One level basement below footprint of the new house and less than 4 metres beyond the rear main wall of the building.	✗	✗	✓	✓	✓	✓	✓	✓
Type 4	New Building with basement excavation Boundary to boundary excavation and/or more than one level and projecting beyond the building footprint of the original building.	✗	✗	✓	✓	✓	✓	✓	✓
✗	Development should not be permitted								
✓	The LB of Haringey should, as a minimum maintain a register in conjunction with Building Control of subterranean development that falls under permitted development rights, existing and proposed, to monitor the potential cumulative impact of subterranean development on the drainage regime. Prior to commencement of construction on basement development, assessments shall be submitted and approved by the London Borough of Haringey to demonstrate: - There are suitable assessments to demonstrate there is no risk from surface water, groundwater and/or fluvial flooding. - Basement extensions in flood risk areas do not contain sleeping accommodation. - There is an internal access to upper levels from the basement extension.								
(i)	It is recommended that regulation of basement development be applied through the building control process.								
(ii)	If the proposal lies within a RiM outline a reservoir breach analysis should be included in a FRA. RiM outlines can be found at https://www.environment-agency.gov.uk/homeandbusiness/floods/default.aspx								
	The LB of Haringey should, as a minimum maintain a register in conjunction with Building Control of subterranean development that falls under permitted development rights, existing and proposed, to monitor the potential cumulative impact of subterranean development on the drainage regime.								
✓	A FRA appropriate to the size and scale of the basement extension will be required to support the planning application.								
✓	A FRA appropriate to the size and scale of the basement extension will be required to support the application, the FRA should be able to demonstrate that there will be no increase in surface water run off as a minimum, with an aim to reduce the overall surface water run off from the proposed development.								
✓	There should be no sleeping accommodation in the basement extension and internal access can be provided to upper levels. A FRA must be submitted for approval. In addition, it should be shown that there is egress from the development to an area outside of National Reservoir inundation mapped flood outline.								
✓	The FRA will need to demonstrate that the basement extension does not impact upon the existing hydro geological regime and that flood risk from groundwater is not increases to the development or to third parties.								

Figure 6. Basement and Flood risk

6.7 Figure 6 that in FZ1 basement development is appropriate subject to findings of the FRA. In case of risk from flooding from reservoirs no sleeping accommodation is allowed, but this risk is not relevant to the site as explained in the next section of this report.

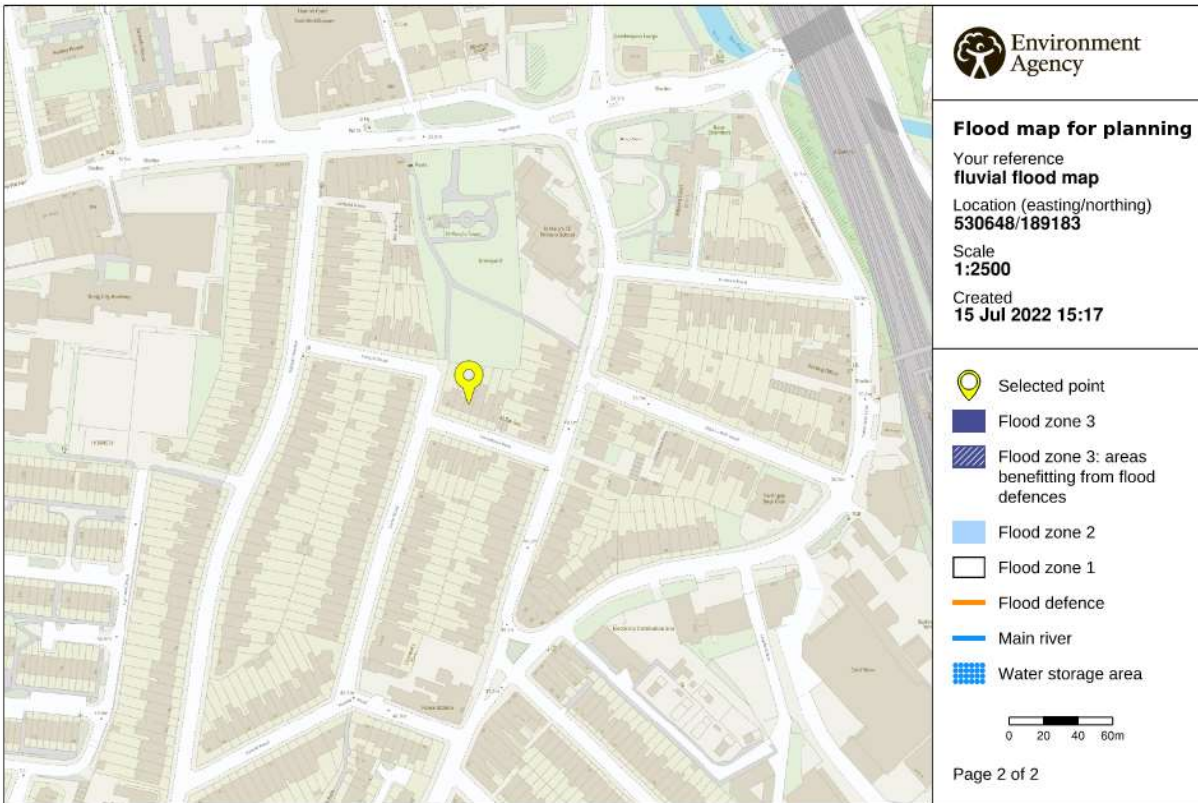
7.0 Climate Change

7.1 The NPPF requires development to take account of the impacts of climate change. The allowances to be made for climate change effects when assessing flood risk are related to the lifetime of the development.

7.2 Guidance from the Environment Agency titled ‘Flood risk assessments: climate change allowances’ was published in February 2016. Climate change allowances are predictions of anticipated change for peak river flow, peak rainfall intensity, sea level rise, offshore wind speed and extreme wave height. There may be circumstances where local evidence supports using other data or allowances. Climate change allowances are set out below.

7.3 Peak River Flow Allowances

7.3.1 Peak river flow allowances show the anticipated changes to peak flow based on the site’s management catchment. The site lies in the London Management Catchment (Department for Environment Food and Rural Affairs, 2022). However, the site is in Flood Zone 1, as shown in Figure 7 below, and has a ‘low’ probability of flooding from rivers and the sea and therefore peak river flow allowance are not relevant.



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Figure 7: EA Flood Zone Map

7.4 Peak Rainfall Intensity Allowances

7.4.1 Drainage systems need to be designed to make sure there is no increase in the rate of runoff discharged from the site for the upper end allowance. As a minimum, there should be no significant flood hazard to people from on-site flooding for the central allowance. According to the Environment Agency guidance on climate changes allowances, for developments with a lifetime of beyond 2100, FRAs should consider the upper end allowance for both the 1.0% and 3.3% annual exceedance probability events for the 2070s epochs (2061-2125).

Range	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Central	5%	10%	20%

Figure 8. Peak rainfall intensity allowance in small catchments (less than 5km2) or urban drainage catchments (based on a 1961 to 1990 baseline) shows the total potential change anticipated for the 2080s (2070 to 2115) is 20% for the central category and 40% for the upper end category

8.0 Site Specific Flood Risk

8.1 Flooding from Rivers and Sea

- 8.1.1 Fluvial flooding is caused by rivers, watercourses or ditches overflowing. It can also be caused by excessive snow melt or exacerbated by high tides and storm surges for rivers with tidal influences.
- 8.1.2 The Environment Agency's Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences, and show the extent of the natural floodplain and the additional extent of an extreme flood. In Flood Zone 1 ("Low Probability"), there is a less than 1 in 1000 chance of river and sea flooding occurring each year.
- 8.1.3 The Environment Agency's Flood Map for Planning, reproduced in Figure 9 and contained in Appendix B, indicates that the site is unaffected by any floodplain and falls entirely within Flood Zone 1 where flooding from rivers and the sea is very unlikely.

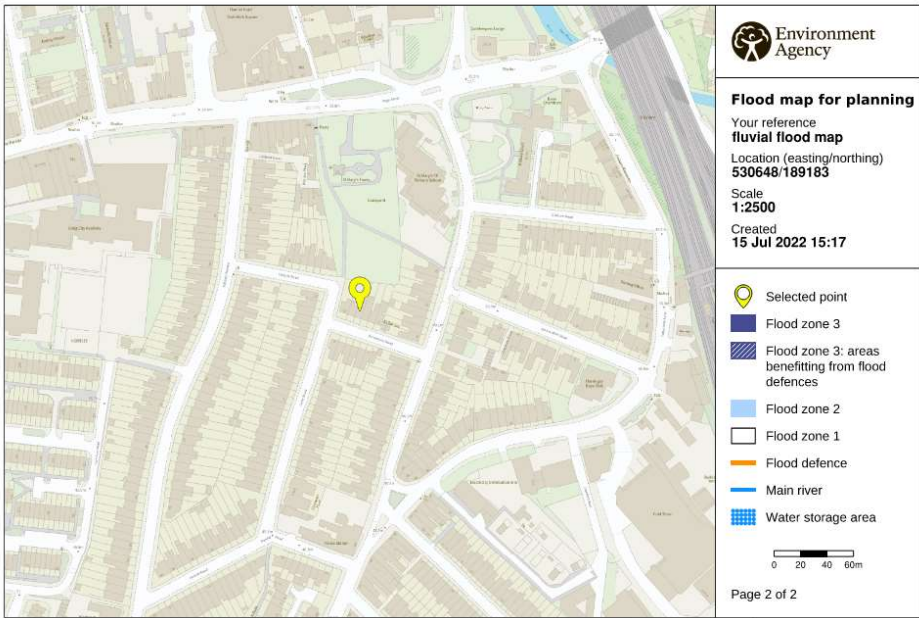


Figure 9: EA Flood Map for Planning

8.1.4 The probability of flooding from rivers and sea is assessed as 'Very Low'.

8.2 Flooding from Surface Water

- 8.2.1 Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground but lies on or flows over the ground instead, resulting in overland flow or ponding. Overland run-off follows the gradient of the land, whereas ponding occurs when overland flows reach low lying areas. These flood events tend to have a short duration and depend on factors such as geology, topography, rainfall, saturation, extent of urbanisation and vegetation.
- 8.2.2 The Environment Agency's Risk of Flooding from Surface Water map for the proposed development, taken from the GOV.UK website, is shown in Figure 9, below. It shows the site being in an area of 'Low' risk of flooding from surface water.



Figure 10: Surface Water Flooding - Extent

- 8.2.3 The LB of Haringey SWMP completed an analysis of the number of properties at risk of flooding for the 1 in 100 year rainfall event and reviewed the potential number of properties with surface water flooding of a depth greater than 0.03m. A review of the numbers of properties affected coupled with local knowledge of the study area identified 9 Critical Drainage Areas.
- 8.2.4 As shown in Figure 11 below, the site is within CDA Group_055

Figure 11. Critical Drainage Areas

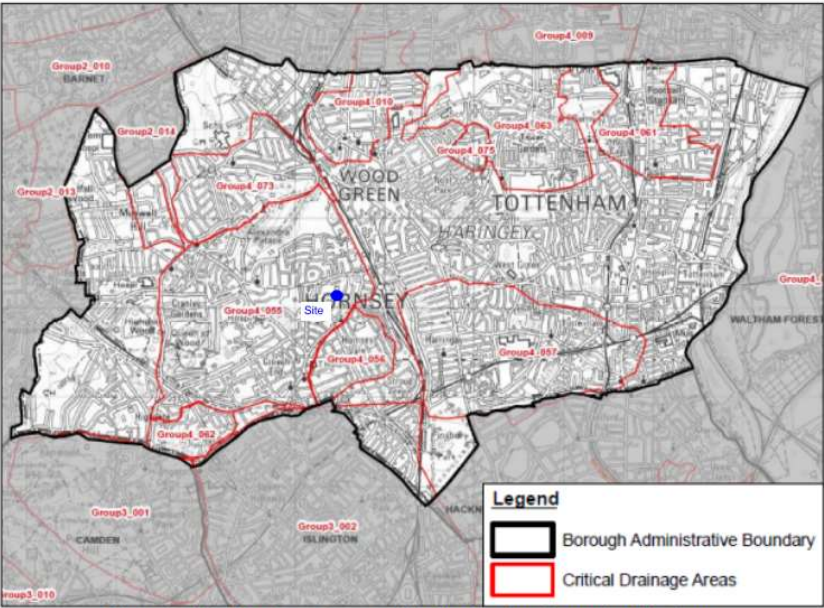


Figure i Critical Drainage Areas within the London Borough of Haringey

8.2.5 SWMP describes this area pinch point' for a large upstream surface water catchment the railway embankment being an obstacle to overland flow. A more detailed map of predicted flood depth is shown in Figure 12 below.

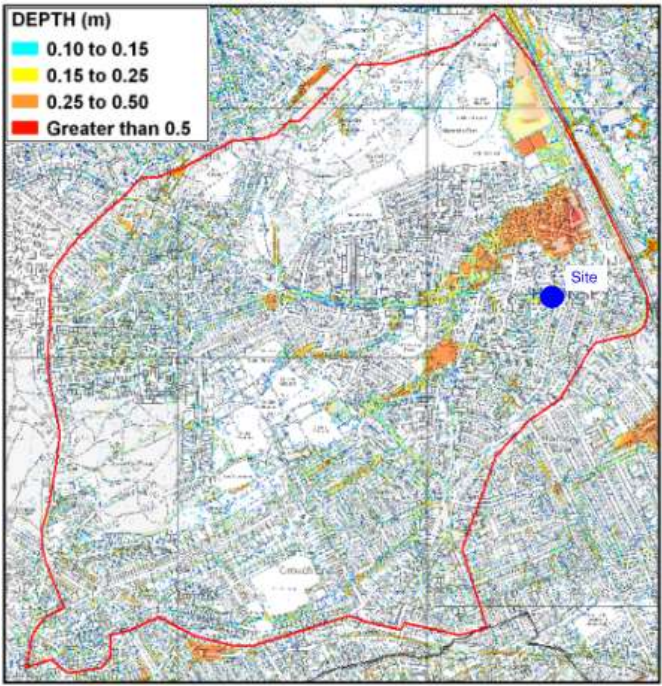


Figure 12. Surface Water Flood Risk Map

- 8.2.6 This flood distribution is consistency with the EA Surface Water Maps and shows the risk is mainly limited to those areas north of High St, with little or no impact to the site.
- 8.2.7 As a result of further consideration of the mapping, the probability of flooding from surface water is considered to be 'Low'.

8.3 Flooding from Groundwater

- 8.3.1 Groundwater flooding occurs as a result of water rising from the underlying rocks or water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall. Higher rainfall means more water will infiltrate into the ground and cause the water table to rise above normal levels. In low-lying areas, the water table is usually at shallower depths, so during very wet periods, all the additional groundwater flowing towards these areas can cause the water table to rise to the surface causing groundwater flooding.
- 8.3.2 As shown in Haringey in Increased potential of elevated ground water map shown below, the site is not in an area at risk.

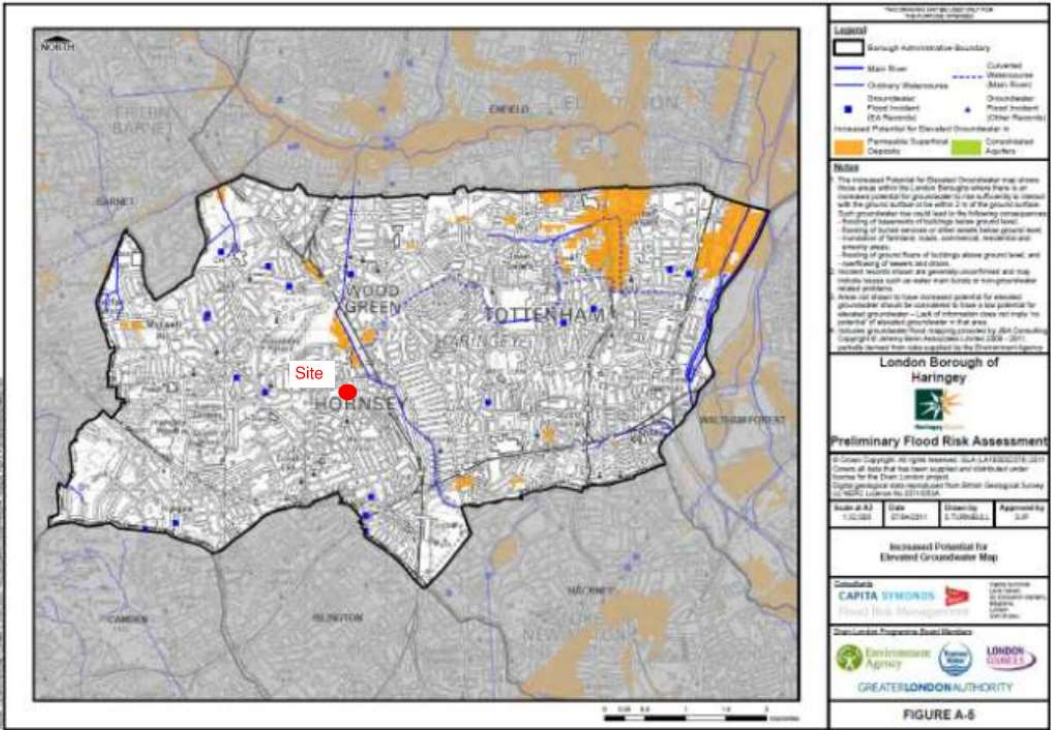


Figure 13. Risk of increase potential for elevated groundwater map

- 8.3.3 As stated in the Site Investigation report, no groundwater was recorded during the ground investigation works or during the return monitoring
- 8.3.4 Based on the evidence above, the risk of groundwater flooding is assessed as 'Very Low'.

8.4 Flooding from Sewers and Drainage Systems

- 8.4.1 Flooding from sewers and drainage systems occurs when the sewer or drainage system is overwhelmed as a result of a blockage or excessive flow exceeding its capacity.
- 8.4.2 A Sewer Flooding History Enquiry of the Thames Water sewer flooding resulted in 'no incidents as a result of surcharging public sewers'. The history enquiry is contained in Appendix A.

8.4.3 On this basis, the risk of flooding from sewers and drainage systems is assessed as ‘Very Low’.

8.5 Flooding from Artificial Sources

- 8.5.1 Artificial sources of flood risk include waterbodies that have been amended by means of human intervention. Where infrastructure retains, transmits or controls the flow of water, flooding may occur if there is a structural, hydraulic, geotechnical or mechanical failure of the infrastructure.
- 8.5.2 The risk of inundation to the LB of Haringey as a result of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation Reservoir Maps (NRIM) 48 study. Extract can be found in Figure 14 below.

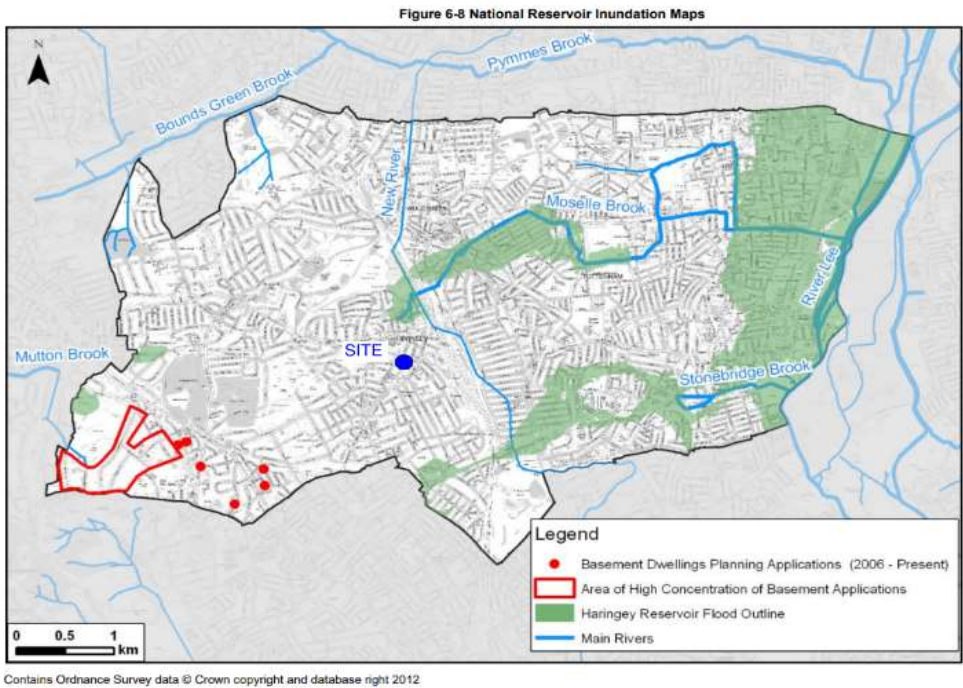


Figure 14. Reservoir Inundation Maps

8.5.3 Based on the information above, the risk of flooding from artificial sources is assessed as ‘Very Low’.

8.6 London Flood Review

- 8.6.1 The London Flood Review was set up to examine the flash flooding that affected many parts of the capital in July 2021. The review has sought to better understand the extent and causes of these floods, to assess how the drainage systems performed, and to recommend how the increasing risks of future flooding events can be managed.
- 8.6.2 The review, commissioned by Thames Water, will play an integral part in ensuring the company future proofs its infrastructure to protect its customers, their communities and the environment as such severe weather events look set to become the norm across the UK.
- 8.6.3 A Root Cause Analysis (RCA) has been undertaken to determine within each London Borough the key flooding areas (known from here as ‘Hotspots’) from both the 12 and 25 July events and to assess the likely associated flooding mechanisms. Any difference of flooding mechanisms between the two events will be detailed specifically where identified. All flooding Hotspots have been captured based on identifying clusters of reported incidents with the boundaries of the Hotspots following (where practicable) the sewer model sub catchments. The model subcatchments identify which houses drain to each manhole and as such are a useful boundary for grouping together houses that are likely to be impacted.

8.6.4 Figure 15 below shows the RCA map for Haringey.

Figure 4.6: London Borough of Haringey - Root Cause Analysis

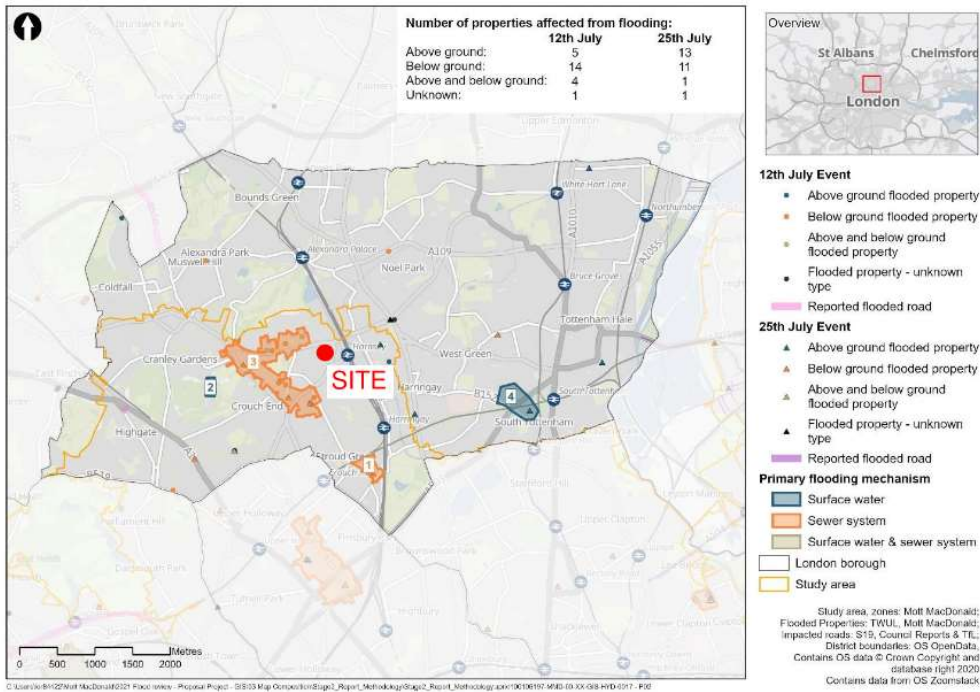


Figure 15. Root Cause Analysis Map

8.6.5 As shown in the RCA maps, the site is not in a hotspot area of surface or sewer flood risk

8.7 Summary of Flood Risk

8.7.1 A summary of the potential flood risks associated with existing conditions (pre-development) is shown in Table 3, below.

Flood Source	Potential Risk			
	Very Low	Low	Medium	High
Fluvial (rivers and sea)	√			
Surface Water		√		
Ground Water	√			
Sewers and Drainage Systems	√			
Artificial Sources	√			
Overall	√			

Figure 16 Pre-development Potential Flood Risk from All Sources of Flooding

8.7.2 The pre-development potential flood risk from all sources of flooding is considered to be ‘Low’.

9.0 Flood Risk Management

9.1 Run-Off Assessment

9.1.1 The Environment Agency’s ‘Rainfall runoff management for developments – Report SC030219’ sets out interim national procedure principles so that

“stormwater runoff rates and volumes discharged from urban developments should approximate to the site greenfield response over a range of storm frequencies of occurrence (return periods) and managed runoff on site for extreme events.

This requires:

- the peak rate of stormwater run-off to be limited*
- the volume of run-off to be limited*
- the pollution load to receiving waters from stormwater runoff to be minimised*
- the assessment of overland flows and temporary flood storage across the site”*

9.1.2 The existing site is approximately 58sqm and 100% impermeable , Therefore the new proposals do not increase runoff volumes

9.1.3 According to Table 26.2 *Pollution hazard indices for different land use classifications* of The SUDS Manual (CIRIA, 2015) the pollution hazard level is ‘Very low’ for residential roofs and ‘low’ for property driveways.

9.1.4 Overland flows are to be collected within the proposed drainage system. Flood storage will not be displaced as the site does not lie within a flood storage area.

9.1.5 Greenfield rates has been calculated using UkSuDS Greenfield rate estimation tool. A Qbar of 4.43 l/s/ha has been obtained. Given the 50sqm of footprint of the site, the greenfield rate is 0.02 l/s. Such a low flow rate is not practicably achievable and therefore a flowrate of 1 l/s should be considered for the design of the drainage system.

9.1.6 A attenuation volume of 0.9 m3 has been calculated with Microdrainage to achieve a maximum flowrate of 1 l/s for all rainfall events up to the 1 in 100 + 40% climate change allowance.

9.2 Sustainable Urban Drainage

9.2.1 The introduction of Sustainable Drainage Systems (SuDS) contributes to mitigate the risk of flood risk by reducing the impact of large rainfall events. By reducing runoff rates, SuDS help to decrease of risk of surface water and sewer flooding.

9.2.2 A SuDS Assessment has been carried out using the guidance set out in The London Plan published by Greater London Authority and The SuDS Manual published by CIRIA. SuDS techniques were assessed as possible surface water disposal methods and priority was given to SuDS which provide multi-functional benefits in line with the drainage hierarchy. Table 5, below, presents the drainage hierarchy taken from Policy SI 13 Sustainable drainage of The London Plan. The feasibility of incorporating different SuDS into the development proposals is outlined.

Method	Feasibility	Explanation
Rainwater harvesting (including a blue roofs)	✖	Site constraints and reduced size make unpracticable the installation of rainwater harvesting devices
Infiltration to ground techniques	✖	Ground conditions and site constraints are not compatible with infiltration due to the presence of London Clay
Rainwater attenuation in open water features and gradual release	✖	There is not space on site for the construction of open water features
Rainwater discharge direct to a watercourse	✖	There is no watercourse in the close enough vicinity to the site to make discharge to a watercourse a feasibility option.

Rainwater attenuation above ground (including blue roofs)	✖	Site constraints and reduced size make unpracticable the installation of bluroofs
Rainwater attenuation below ground	✓	Below ground attenuation at the front garden along with orifice flow control is feasible
Discharge surface water to a surface water drain or drain	✓	A new connection public surface water sewer in the vicinity of the site is possible
Discharge rainwater to the combined sewer	✖	It is proposed to re-use existing surface water sewer connections into the public surface water sewer.

Table 1: SUDS Hierarchy

9.3 Resistance, Resilience and Mitigation Measures

The guidance document ‘Improving the Flood Performance of New Buildings: Flood Resilient Construction’ was produced as part of the Department for Communities and Local Government Buildings Regulations (Sanitation) Research Framework, and the joint Defra/Environment Agency Flood Risk Management Research and Development programme. It defines flood resistance as:

Constructing a building in such a way to prevent floodwater entering the building and damaging its fabric.

- 9.3.1 Given the low overall risk from all sources , it’s considered water resilience (water inclusion) measures are not required. Proposed measures are considered to provide further mitigation and ensure the flood resistance of the building
- 9.3.2 Slot channels at threshold will prevent runoff from entering the property.
- 9.3.3 Attenuation in the form of below ground tank or chamber will reduce runoff rates to 1 l/s and limit the risk of surface and sewer flooding.
- 9.3.4 Non-return valves to be installed at the connection to the foul sewer will prevent basement flooding due to sewer surcharge.
- 9.3.5 The site is not within an area of flood warnings or alerts.
- 9.3.6 As a precaution, it is recommended that the owners obtain adequate flood insurance to manage risk and minimise potential economic losses.

9.4 Drainage Strategy

- 9.4.1 An outline drainage strategy has been developed. It is proposed runoff is attenuated to 1 l/s to for all rainfall events up to the 1 in 100 +40% climate changes storm.
- 9.4.2 Attenuation is provided by a 1 m deep 1.2m diameter manhole fitted with a 25mm orifice plate flow control.
- 9.4.3 New foul and surface water connections to the respective Thames Water sewers in Ferrestone Road are required. Connections are subject to Thames Water Section 106 approvals.
- 9.4.4 Outline drainage strategy can be found in Appendix C
- 9.4.5 Microdrainage calculations can be found in Appendix D

9.5 Operation and Maintenance

- 9.5.1 The drainage strategy has been designed such that the foul and surface water pipes conform with Building Regulations Part H. This ensures operation of the drainage system is fit for purpose.
- 9.5.2 Gullies and channels will be specified with silt buckets to prevent the ingress of silts into the drainage network and impairing the performance of the system.
- 9.5.3 A maintenance regime to ensure efficient functioning of the drainage system is recommended.
- 9.5.4 All waste arising from the maintenance of the drains and sewers shall be handled, stored and disposed of correctly to avoid pollution. Waste may be designated as hazardous / special waste and, as such, the End User shall ensure that they comply with the Hazardous Waste (England and Wales) Regulations 2005.

10.0 Conclusions

- 10.1 In accordance with the National Planning Policy Framework, the site would be categorised as lying within Flood Zone 1 – an area assessed as having 1 in 1000 or less annual probability of river or sea flooding (<0.1%).
- 10.2 In accordance with the NPPF, the proposed development is classified as ‘more vulnerable’ land use.
- 10.3 Land use in the proposed development is acceptable under the terms of Sequential Test and there is no requirement for an Exception Test to be carried out.
- 10.4 The site is at ‘Very Low’ risk for fluvial flooding.
- 10.5 The site has been assessed as being at ‘Low’ risk from surface water flooding.
- 10.6 The site has been assessed as being at ‘Very Low’ risk from groundwater sources.
- 10.7 The site has been assessed as being at ‘Very Low’ risk from surcharging sewers.
- 10.8 The site has been assessed as being at ‘Very Low’ risk from artificial sources.
- 10.9 The overall flood risk to the site is assessed as ‘Low’.
- 10.10 The provision of the surface water drainage will reduce the surface water flood risk.
- 10.11 The comments stated above are based on information received from other consultees. The flood risk classification of this site has been based on the above observations, and the recommendations stated.

APPENDIX A

SEWER RECORDS

Symmetrys Limited
Unit 6 The Courtyard Unit 6 The Courtyard

LONDON
N8 8SL

Search address supplied 1
Ferrestone Road
London
N8 7BX

Your reference Ferrestone Road

Our reference ALS/ALS Standard/2022_4664317

Search date 15 June 2022

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.



Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13



searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk



0800 009 4540

Search address supplied: 1, Ferrestone Road, London, N8 7BX

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk

Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.



For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

[illegible]

The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 530658,189149

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map (2020) with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
7209	38.37	36.85
7206	36.81	34.55
7207	36.93	34.17
7208	37.22	36.52
721C	n/a	n/a
721A	n/a	n/a
721D	n/a	n/a
7101	38.89	36.42
721B	n/a	n/a
6001	45.81	42.36
611B	n/a	n/a
611A	n/a	n/a
611D	n/a	n/a
6103	40.81	38.85
6104	41.07	38.58
711C	n/a	n/a
7001	43.66	42.34
7002	43.7	40.96
501A	n/a	n/a
601A	n/a	n/a
5001	45.08	41.69
5004	44.79	42.08
611C	n/a	n/a
6102	38.66	35.46
6101	38.33	35.68
521A	n/a	n/a
6203	36.63	33.64
6202	36.32	33.8
621A	n/a	n/a
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

	Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	Storm Sewer
	Sludge Sewer
	Foul Trunk Sewer
	Surface Trunk Sewer
	Combined Trunk Sewer
	Foul Rising Main
	Surface Water Rising Main
	Combined Rising Main
	Vacuum
	Thames Water Proposed
	Vent Pipe
	Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

	Sewer		Culverted Watercourse
	Proposed		Decommissioned Sewer
	Content of this drainage network is currently unknown		Ownership of this drainage network is currently unknown

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plan are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

	Air Valve		Meter
	Dam Chase		Vent
	Fitting		

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

	Ancillary		Drop Pipe
	Control Valve		Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol. Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

	Inlet		Outfall
	Undefined End		

Other Symbols

Symbols used on maps which do not fall under other general categories.

	Change of Characteristic Indicator		Public / Private Pumping Station
	Invert Level		Summit

Areas

Lines denoting areas of underground surveys, etc.

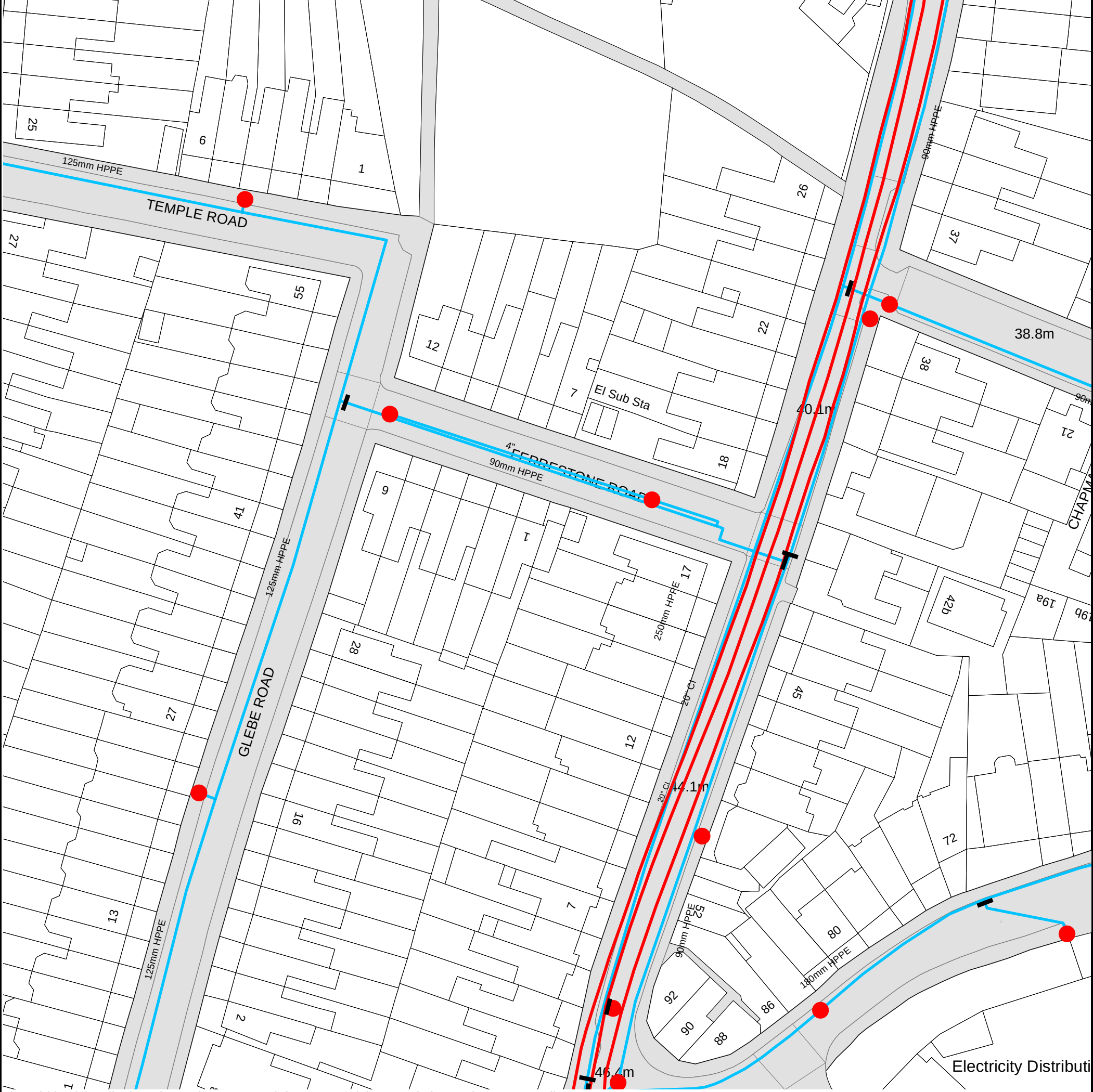
	Agreement
	Chamber
	Operational Site

Ducts or Crossings

	Casement	Ducts may contain high voltage cables. Please check with Thames Water.
	Conduit Bridge	
	Subway	
	Tunnel	

5) 'na' or '0' on a manhole indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 530658, 189149.
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

- Distribution Main:** The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.
- Trunk Main:** A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.
- Supply Main:** A supply main indicates that the water main is used as a supply for a single property or group of properties.
- Fire Main:** Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.
- Metered Pipe:** A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.
- Transmission Tunnel:** A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.
- Proposed Main:** A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger
- Casement:** Ducts may contain high voltage cables. Please check with Thames Water.

Other Water Pipes (Not Operated or Maintained by Thames Water)

- Other Water Company Main:** Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.
- Private Main:** Indicates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL's terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call 0800 009 4540 quoting your invoice number starting CBA or ADS / OSS	Account number 90478703 Sort code 60-00-01 A remittance advice must be sent to: Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW. or email ps.billing@thameswater.co.uk	By calling your bank and quoting: Account number 90478703 Sort code 60-00-01 and your invoice number	Made payable to ' Thames Water Utilities Ltd ' Write your Thames Water account number on the back. Send to: Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW or by DX to 151280 Slough 13

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Sewer Flooding

History Enquiry



Property
Searches

Symmetrys Limited

Search address supplied 1
Ferrestone Road
London
N8 7BX

Your reference Ferrestone Road

Our reference SFH/SFH Standard/2022_4664321

Received date 15 June 2022

Search date 15 June 2022



Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13



searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk



0800 009 4540

Sewer Flooding

History Enquiry



Property
Searches

Search address supplied: 1, Ferrestone Road, London, N8 7BX

This search is recommended to check for any sewer flooding in a specific address or area

TWUL, trading as Property Searches, are responsible in respect of the following:-

- (i) any negligent or incorrect entry in the records searched;
- (ii) any negligent or incorrect interpretation of the records searched;
- (iii) and any negligent or incorrect recording of that interpretation in the search report
- (iv) compensation payments



Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13



searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk



0800 009 4540

History of Sewer Flooding

Is the requested address or area at risk of flooding due to overloaded public sewers?

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers.

For your guidance:

- A sewer is “overloaded” when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- “Internal flooding” from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- “At Risk” properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company’s reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0800 316 9800 or website www.thameswater.co.uk



Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13



searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk



0800 009 4540



SYMMETRYS
STRUCTURAL / CIVIL ENGINEERS

APPENDIX B EA FLOOD MAP FOR PLANNING

Flood map for planning

Your reference
fluvial flood map

Location (easting/northing)
530648/189183

Created
15 Jul 2022 15:17

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following**:

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

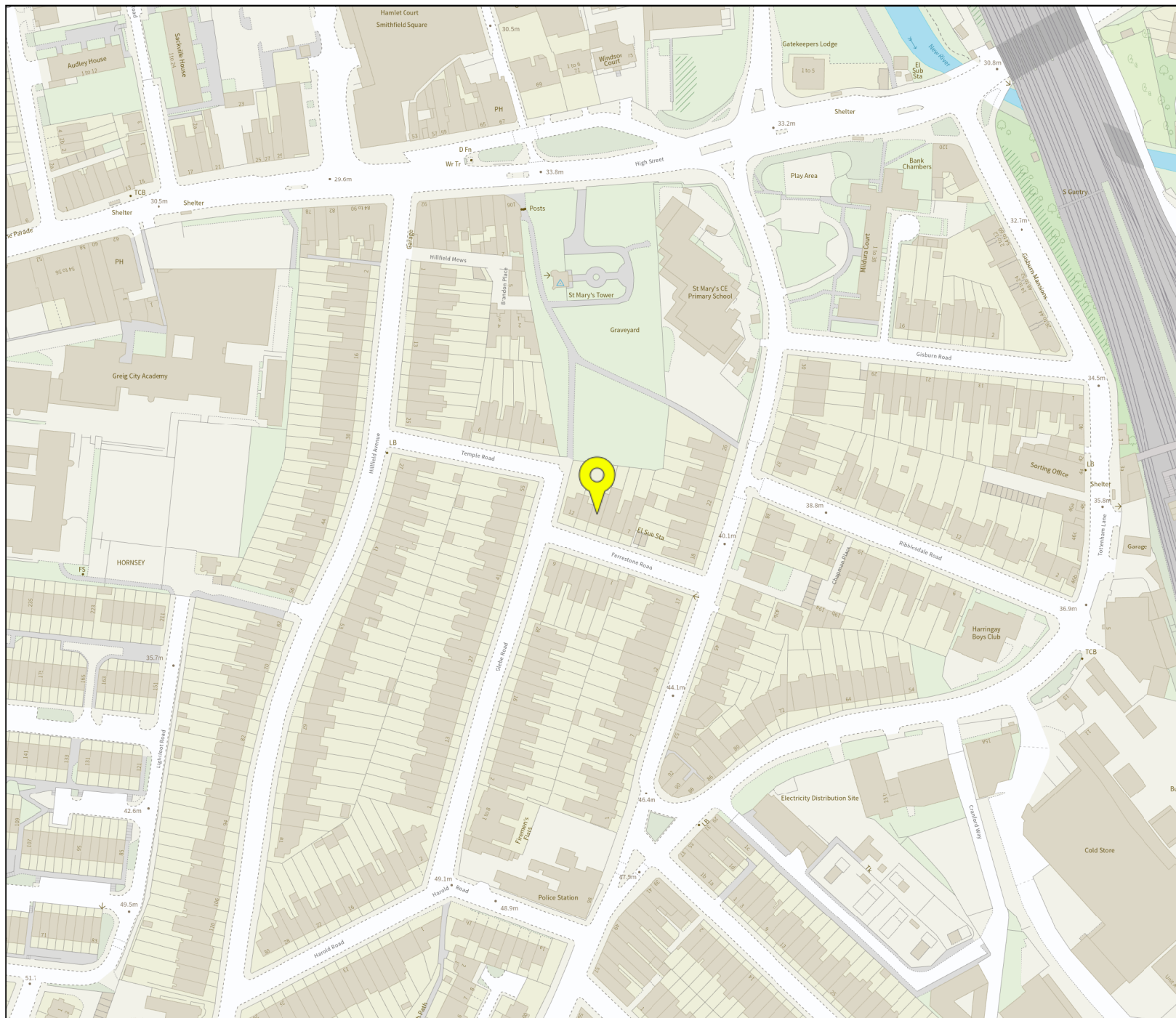
Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2021 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>



Flood map for planning

Your reference
fluvial flood map

Location (easting/northing)
530648/189183

Scale
1:2500

Created
15 Jul 2022 15:17

-  Selected point
-  Flood zone 3
-  Flood zone 3: areas benefitting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area


0 20 40 60m

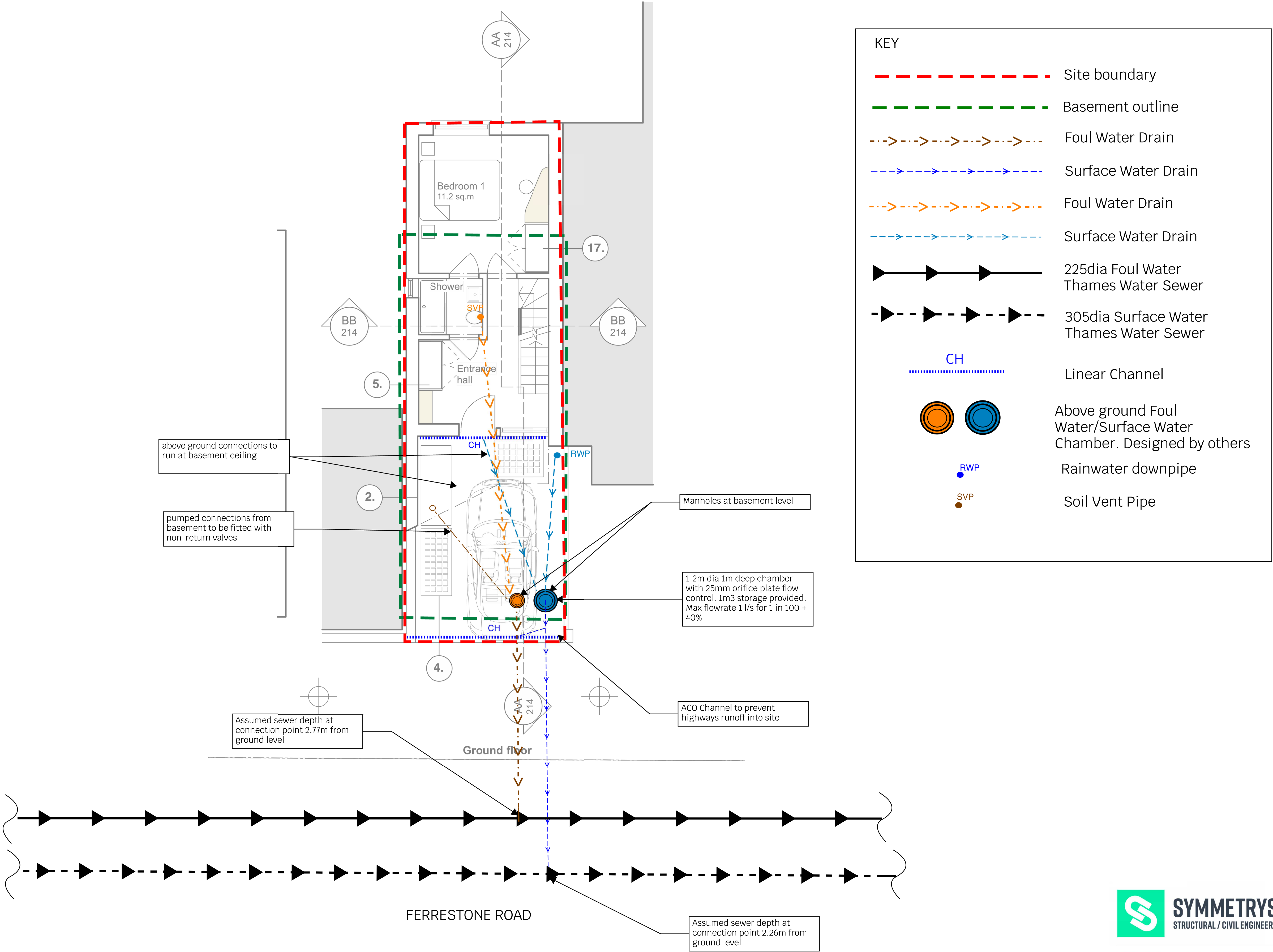


SYMMETRYS
STRUCTURAL / CIVIL ENGINEERS

APPENDIX C

OUTLINE DRAINAGE STRATEGY

1. Drainage strategy indicative only
2. Connections to Thames Water sewer subject to S106 agreement
3. Above ground drainage to be designed by specialist



APPENDIX D

CALCULATIONS

Symmetrys Limited		Page 1
Unit 6, The Courtyard Lynton Road, Crouch End London, N8 8SL		
Date 16/09/2022 12:43 File 22135 SURFACE WATER.MDX	Designed by Yaré Perez Checked by	
Innovyze Network 2020.1.3		

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	20.500	Add Flow / Climate Change (%)	0
Ratio R	0.436	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	5.000	0.085	58.8	0.005	5.00	0.0	0.600	o	100	Pipe/Conduit	
S1.001	5.000	0.085	58.8	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	I.Area (ha)	Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	7.500	0.005	0.0	0.0	0.0	1.01	7.9	0.7
S1.001	50.00	5.17	7.415	0.005	0.0	0.0	0.0	1.01	7.9	0.7

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.436
Return Period (years)	5	Profile Type	Summer
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.500	Cv (Winter)	0.840

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Symmetrys Limited		Page 2
Unit 6, The Courtyard Lynton Road, Crouch End London, N8 8SL		
Date 16/09/2022 12:43 File 22135 SURFACE WATER.MDX	Designed by Yaré Perez Checked by	
Innovyze Network 2020.1.3		
<u>Synthetic Rainfall Details</u> Storm Duration (mins) 30		
©1982-2020 Innovyze		

Symmetrys Limited		Page 3
Unit 6, The Courtyard Lynton Road, Crouch End London, N8 8SL		
Date 16/09/2022 12:43 File 22135 SURFACE WATER.MDX	Designed by Yaré Perez Checked by	
Innovyze	Network 2020.1.3	
<u>Online Controls for Storm</u> <u>Orifice Manhole: S2, DS/PN: S1.001, Volume (m³): 0.1</u> Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 7.415		
©1982-2020 Innovyze		

Symmetrys Limited			Page 5																																							
Unit 6, The Courtyard Lynton Road, Crouch End London, N8 8SL																																										
Date 16/09/2022 12:43 File 22135 SURFACE WATER.MDX		Designed by Yaré Perez Checked by																																								
Innovyze		Network 2020.1.3																																								
<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>																																										
<u>Simulation Criteria</u>																																										
Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000																																										
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000																																										
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800																																										
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000																																										
Foul Sewage per hectare (l/s) 0.000																																										
Number of Input Hydrographs 0 Number of Storage Structures 1																																										
Number of Online Controls 1 Number of Time/Area Diagrams 0																																										
Number of Offline Controls 0 Number of Real Time Controls 0																																										
<u>Synthetic Rainfall Details</u>																																										
Rainfall Model FSR Ratio R 0.437																																										
Region England and Wales Cv (Summer) 0.750																																										
M5-60 (mm) 20.500 Cv (Winter) 0.840																																										
Margin for Flood Risk Warning (mm) 300.0																																										
Analysis Timestep 2.5 Second Increment (Extended)																																										
DTS Status OFF																																										
DVD Status ON																																										
Inertia Status ON																																										
Profile(s) Summer and Winter																																										
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440																																										
Return Period(s) (years) 1, 30, 100																																										
Climate Change (%) 0, 40, 40																																										
<table><tr><td colspan="3"></td><td>Water</td><td>Surcharged</td><td>Flooded</td><td colspan="2"></td></tr><tr><td>PN</td><td>US/MH Name</td><td>Event</td><td>US/CL (m)</td><td>Level (m)</td><td>Depth (m)</td><td>Volume (m³)</td><td>Flow / Cap.</td></tr><tr><td>S1.000</td><td>S1</td><td>15 minute 30 year Winter I+40%</td><td>8.000</td><td>7.796</td><td>0.196</td><td>0.000</td><td>0.13</td></tr><tr><td>S1.001</td><td>S2</td><td>30 minute 30 year Winter I+40%</td><td>8.000</td><td>7.838</td><td>0.323</td><td>0.000</td><td>0.11</td></tr></table>									Water	Surcharged	Flooded			PN	US/MH Name	Event	US/CL (m)	Level (m)	Depth (m)	Volume (m³)	Flow / Cap.	S1.000	S1	15 minute 30 year Winter I+40%	8.000	7.796	0.196	0.000	0.13	S1.001	S2	30 minute 30 year Winter I+40%	8.000	7.838	0.323	0.000	0.11					
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